DEC 2 8 2020

Joint DENR - DA Administrative Order
No. 2020 - 02

SUBJECT: ADOPTING THE NATIONAL INVASIVE SPECIES STRATEGY AND ACTION PLAN-PHILIPPINES: 2020-2030 AS THE NATIONAL FRAMEWORK FOR THE MANAGEMENT OF INVASIVE ALIEN SPECIES IN THE COUNTRY

In pursuit of the objectives of the Wildlife Resources Conservation and Protection Act (Republic Act No. 9147), the Expanded National Integrated Protected Areas System (NIPAS) Act (Republic Act No. 11038), the Plant Quarantine Law (Presidential Decree No. 1433), the Amended Philippine Fisheries Code of 1998 (Republic Act No. 10654), and the Philippine commitments under the Convention on Biological Diversity (CBD), and to address the threats of invasive alien species (IAS) to Philippine biodiversity, economy and social welfare, the National Invasive Species Strategy and Action Plan (NISSAP) for the Philippines (2020-2030) attached hereto as "Annex A" is hereby adopted for information and guidance of all concerned.

The NISSAP provides nine (9) strategic goals towards a holistic, collaborative and multi-sectoral approach in managing the risks of IAS. These are: (1) leadership and coordination; (2) prevention; (3) early detection and rapid response; (4) control and management; (5) restoration; (6) research and information management; (7) education and public awareness; (8) international cooperation; and (9) training needs. Each of the nine strategic goals provide its guiding principles, objectives, implementing guidelines and planned actions spanning three timelines – short term (2020-2021), medium term (2022-2023) and long-term (2024-2030).

The Department of Environment and Natural Resources (DENR) through the Biodiversity Management Bureau (BMB), Ecosystems Research and Development Bureau (ERDB), Forest Management Bureau (BMB), and Environmental Management Bureau (EMB); and the Department of Agriculture (DA) through the Bureau of Plant Industry (BPI), Bureau of Fisheries and Aquatic Resources (BFAR), and Bureau of Animal Industry (BAI) shall disseminate the NISSAP, undertake capacity building for field offices and other relevant agencies, coordinate the conduct of surveys and researches, undertake public awareness campaigns, and develop specific policy guidelines to ensure efficient and effective implementation of the NISSAP by all concerned.

The DENR, through the BMB and the DA through its Policy Research Service shall facilitate the creation of the inter-agency coordinating body for IAS. Further, the DENR and DA, in collaboration with other concerned agencies and stakeholders are hereby authorized to coordinate the implementation and mainstreaming of the NISSAP with the plans and programs of concerned national government agencies and local government units including government-owned and controlled corporations and government financial institutions and state universities and colleges. The NISSAP shall be revised and updated as often as necessary to integrate relevant developments on IAS management.

Funds for the implementation of the NISSAP shall be included in the annual budgetary proposal of concerned DENR and DA offices.

All Department Orders, Circulars, and other issuances consistent herewith are hereby amended, repealed, or modified accordingly.

This Order shall take effect immediately.

ROY A. CIMATU
Secretary
Department of Environment and Natural Resources

WILLIAM D. DAR, PH.D.
Secretary
Department of Agriculture

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September 27, 2021

Acknowledgement: U.P. Law Center
September 27, 2021

Foreword

The incursion of alien species, alongside with habitat destruction and resource exploitation, has been blamed for biodiversity loss. In the same light, these invasive species disturb habitats and ecosystems and pose threats to human health. They also cause detrimental effects on the economy by encumbering the agricultural, forestry and fisheries industries. Thus, it was deemed vital to prevent the introduction and spread of invasive species and effectively reduce their impacts on biodiversity.

The Department of Environment and Natural Resources (DENR) through the Biodiversity Management Bureau (BMB) had reached another milestone in addressing the problem of invasive alien species, as called for by the Convention on Biological Diversity (CBD) to which we are signatories to. I am privileged to lead the adoption of this crucial and rationalized blueprint, the National Invasive Species Strategy and Action Plan (NISSAP). With the NISSAP, relevant government agencies, in collaboration with scientific experts and community members, shall be guided towards achieving a coordinated effort to set specific policies, priority projects, and programs to arrest biological invasions.

As we embark on this new and challenging task, I enjoin the active participation and support of all DENR Bureaus and its attached agencies, regional field units, other relevant government departments, local government units, academe, private sector and civil society organizations.

Let us put this plan into tangible actions for the benefit of the environment and society as a whole.

Hon. Roy A. Cimatu
Secretary
Department of Environment and Natural Resources

Republic of the Philippines

Department of Environment and Natural Resources

NISSAP

NATIONAL INVASIVE SPECIES STRATEGY AND ACTION PLAN 2020-2030

NATIONAL INVASIVE SPECIES STRATEGY AND ACTION PLAN 2020-2030

Acknowledgements

The National Invasive Species Strategy and Action Plan (NISSAP) was developed as part of the United Nations Environment Programme-Global Environment Facility (UNEP-GEF) Project No. 0515: Removing Barriers to Invasive Species Management in Production and Protection Forests in Southeast Asia (FORIS Project).

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Invasion of Spiked Pepper (*Piper aduncum)* in Allah Valley Protected Landscape, Lake Sebu, South Cotabato, Philippines. Source: Danilo N. Tandang.

NISSAP Photo, left to right:
N-*Pomacea canaliculata*/golden apple snail. Source: Vivian D. Ang.
I- *Hypostomus plecostomus*/janitor fish. Source: Don T. Dumale.
S-*Monomorium floricola*/bicolored trailing ant. Source: Perry Archival C. Buenavente.
S-*Eichhornia crassipes*/water hyacinth. Source: Edwin R. Tadiosa and Danilo N. Tandang.
A-*Rattus tanezumi*/Oriental house rat. Source: Maria Josefa S. Veluz and Arvin C. Diesmos.
P-*Hylarana erythraea*/green paddy frog. Source: Arvin C. Diesmos.

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Disclaimer

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Table of Contents

List of Tables

List of Figures

List of Boxes

List of Acronyms

ACB	ASEAN Center for Biodiversity
AO	Administrative Order
APFISN	Asia-Pacific Forest Invasive Species Network
ARCBC	ASEAN Regional Center for Biodiversity Conservation
ASEAN	Association of Southeast Asian Nations
BAI	Bureau of Animal Industry
BFAR	Bureau of Fisheries and Aquatic Resources
BMB	Biodiversity Management Bureau
BPI	Bureau of Plant Industry
BWMC	Ballas Water Management Convention; also known as International Convention for the Control and Management of Ships' Ballast Water and Sediments
CABI	Centre for Agriculture and Bioscience International
CBD	Convention on Biological Diversity
CHED	Commission on Higher Education
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CMS	Convention on the Conservation of Migratory Species of Wild Animals; also known as CMS or the Bonn Convention
COP	Conference of Parties
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CSOs	Civil Society Organizations
DA	Department of Agriculture
DAO	Departmental Administrative Order
DENR	Department of Environment and Natural Resources
DepEd	Department of Education
DILG	Department of the Interior and Local Government
DMC	Department Memorandum Circular
DOT	Department of Tourism
ECA	Environmentally Critical Area
ECC	Environmental Compliance Certificate
ECP	Environmentally Critical Project
EDRR	Early Detection and Rapid Response
EIA	Environmental Impact Assessment
EIS	Environmental Impact System
EMB	Environmental Management Bureau
EO	Executive Order
ERDB	Ecosystem Research and Development Bureau
FAO	Fisheries Administrative Order
FARMC	Fisheries and Aquatic Resources Management Council
FIN	Fishbase Information & Research Group Inc.
FMB	Forest Management Bureau
GEF	Global Environment Facility
GMO	Genetically Modified Organism
IAS	Invasive Alien Species
IEE	Initial Environmental Examination
IP	Indigenous People
IPPC	International Plant Protection Convention
IRR	Implementing Rules and Regulations

ISSG	Invasive Species Specialist Group
IUCN	International Union for Conservation of Nature and Natural Resources
LGUs	local government units
LLDA	Laguna Lake Development Authority
MPFD	Master Plan for Forestry Development
NAWMC	National Aquatic Wildlife Management Committee
NBF	National Biosafety Framework
NBF	National Biosafety Framework
NCIP	National Commission on Indigenous Peoples
NEP	National Ecotourism Program
NFRDI	National Fisheries Research and Development Institute
NGO	non-government organization
NGP	National Greening Program
NIPAS	National Integrated Protected Areas System
NISSAP	National Invasive Species Strategy and Action Plan
NPC	National Plant Committee
NWMC	National Wildlife Management Committee
PAMB	Protected Area Management Board
PAWB	Protected Areas and Wildlife Bureau
PBCPP	Philippine Biodiversity Conservation Priority-Setting Program
PBSAP	Philippine Biodiversity Strategy and Action Plan
PCSD	Palawan Council for Sustainable Development
PD	Presidential Decree
PIA	Philippine Information Agency
PNES	Philippine National Ecosystem Strategy
PNP	Philippine National Police
PO	Peoples' Organization
PQD	Plant Quarantine Decree
RA	Republic Act
Ramsar Convention	also known as Convention of Wetlands
RFUs	regional field units
SAPA	Special Uses within Protected Areas
SPS	Sanitary and Phytosanitary Standards
TWG	Technical Working Group
U.S. EPA	United States Environmental Protection Agency
UNCCD	United Nations Convention to Combat Desertification
UNCLOS	United Nations Convention on the Law of the Sea
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
WEOs	Wildlife Enforcement Officers

Foreword

The incursion of alien species, alongside with habitat destruction and resource exploitation, has been blamed for biodiversity loss. In the same light, these invasive species disturb habitats and ecosystems and pose threats to human health. They also cause detrimental effects to the economy by encumbering the agricultural, forestry and fisheries industries. Thus, it was deemed vital to prevent the introduction and spread of invasive species and effectively reduce their impacts on biodiversity.

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Let us put this plan into tangible actions for the benefit of the environment and society as a whole.

Hon. Roy A. Cimatu
Secretary
Department of Environment and Natural Resources

Foreword

The National Invasive Species Strategy and Action Plan (NISSAP) (2020-2030) was crafted to address the adverse impacts of invasive alien species introduced intentionally and unintentionally in the country, and to manage and contain its impacts not only on the integrity of native flora and fauna but also on the agriculture and fishery production systems. History indicates that the entry of invasive alien species costs the government significant amount of resources to manage the damage incurred which is always irreparable.

In the past, invasive alien species introduced in the Philippines included plants, fish, insects, associated vertebrates and invertebrates, pests and pathogens. Among the major species that negatively affected agriculture and fishery sector include lantana (*Lantana camara*), oriental house rat (*Rattus tanezumi*), janitor fish (*Hypostomus plecostomus*), golden apple snail (*Pomacea canaliculata*), brown house-ant (*Pheidole megacephala*), and giant earthworm (*Pheretima spp.*).

A recent invasive alien species that affects the agricultural sector is the Fall Armyworm (*Spodoptera frugiperda*). It is considered as a very dangerous invasive species because it is polyphagous— if left unmanaged, it can damage more than 800 varieties of plants ranging from small grasses to trees. In 2019, it had infested corn plants with an estimated damage of PhP 24 million for Region 1 and Region 2 only.

It is the responsibility of the Department of Agriculture and its agencies to prevent the introduction of invasive alien or exotic species and mitigate and contain their damage and adverse impact. We are pleased to work with the Department of Environment and Natural Resources in implementing this National Invasive Species Strategy and Action Plan.

Hon. William D. Dar
Secretary
Department of Agriculture

Preface

It is my honor to present the National Invasive Species Strategy and Action Plan (NISSAP), the country's response to addressing the impacts of invasive alien species (IAS) to biodiversity. The negative aftermath of the introduction of IAS to ecosystem functions, agricultural production, and human and animal health is a reality in the country that demands intervention lest attaining a sustainable and viable natural ecosystems and food production system is compromised.

Thus, the NISSAP was developed to provide a framework for a coordinated and multi-sectoral approach to prevent further introduction of IAS, control or eradicate ongoing invasions, and restore ecosystems damaged by these species. This is aimed to be achieved through timely, efficient, and judicious enforcement of policies, laws and regulations, supported by science-based research and knowledge sharing. Further, it also promotes heightened awareness and participation of the civil society in responding to IAS problems, as well as in the responsible use of exotic plants and animals.

The NISSAP is a product of a consultative process that represents the consolidated efforts and insights of government agencies, academe, and civil society organizations working in agriculture, biodiversity, and natural resource development sectors. The Biodiversity Management Bureau wishes to thank and commend all those who contributed in coming up with this NISSAP. We look forward to working with you again to realize the vision of this plan for a better environment for us all.

Onward we go to meet the challenges given to us!

Ricardo L. Calderon
Assistant Secretary for Climate Change and
Director, in concurrent capacity, Biodiversity Management Bureau
Department of Environment and Natural Resources

Executive Summary

Biological invasions are growing at an alarming rate worldwide. Invasive species are second only to habitat destruction as drivers of biodiversity loss. The adverse consequences of Invasive Alien Species (IAS) on biodiversity have been increasing over many decades, often in a continuing and very rapid rate, especially on islands, tropical forests, and inland waters (Millennium Assessment, 2005; Pimentel et al., 2001). The impact of IAS on Philippine biodiversity can be insurmountable if a "no-action" policy prevails. To minimize the impact of IAS on biodiversity, economy and human health, there should be timely, efficient, and judicious enforcement of laws and regulations; focused research; enhanced multi-sectoral participation; stronger public awareness and involvement; collective action; and better information exchange. These concerns, among others, were considered in formulating the National Invasive Species Strategy and Action Plan (NISSAP).

The NISSAP is our response to the call of the Convention on Biological Diversity (CBD) to mitigate the threats of IAS and reduce their pressure to biodiversity. As a Contracting Party to the CBD, we adhere to the challenge. Developing the NISSAP enables relevant government agencies to collaborate with experts and other stakeholders. Through NISSAP the government agencies can set clear priorities for the identification of gaps and inconsistencies in the national policy and institutional frameworks relating to IAS; and provide opportunities to integrate them in the country's commitments to CBD and other international treaties and agreements. However, financial, technical, and scientific capacities have to be developed and strengthened to ensure the efficient and effective implementation of NISSAP.

The NISSAP provides a framework for coordinated and multisector management of IAS. It aims to foster cooperation among relevant government and non-government organizations (NGOs), industries, local communities, civil society, and other stakeholders for a collective and coordinated action to reduce the rate of biodiversity loss through the prevention of the introduction and spread of IAS, and minimize their impacts. The NISSAP is consistent with and complementary to the goals of the Philippine Biodiversity Strategy and Action Plan (PBSAP).

The NISSAP is the product of extensive research about IAS in the Philippines hand in hand with a democratic consultative process. The draft NISSAP was posted on the official website of the Biodiversity Management Bureau (BMB), formerly the Protected Areas and Wildlife Bureau (PAWB), for a broader participation. The NISSAP was also built on the comments and suggestions of the IAS National Steering Committee and the IAS Technical Working Group (TWG)-both created by virtue of DENR-S.O. 2012-293--and the IAS Experts Group. Furthermore, the NISSAP drew from the experiences and feedbacks of numerous participants during the various Philippine consultation meetings and workshops held in the country and casual interviews and conversations with practitioners and experts. Comments and suggestions sent through e-mail were also considered.

The consultative process resulted in a comprehensive NISSAP Framework. NISSAP comprises 9 strategic goals to realize its vision and mission: (1) leadership and coordination, (2) prevention, (3) early detection and rapid response, (4) control and management, (5) restoration, (6) research and information management, (7) education and public awareness, (8) international cooperation, and (9) training needs and capacity building. The guiding principles, 9 strategic goals, various implementing guidelines, 16 objectives and 84 planned actions to be implemented are spread across three timelines- the short-term (2020-2021), medium-term (2022-2023), and long-term (2024-2030). The NISSAP is projected to be implemented by virtue of either an Administrative Order or an Executive Order.

I Introduction

Background and Rationale

Biological incursions to the environment have been reported to occur at a disturbing rate. Successful invasion by alien species has already been responsible for many cases of species extinction (Baillie et al., 2004). For example, it accounts for 40% of the extinction of mammals worldwide (Groombridge, 1992). The structure and functions of ecosystems can also be altered by Invasive Alien Species (IAS), which can lead to massive loss of biodiversity. It is predicted that the effects of global climate change will include invasion by alien species and changes in the structure and functions of habitats and ecosystems; furthermore, species formerly regarded as benign may become invasive as a consequence of climate change (Dukes & Mooney, 1999; U.S. EPA, 2008). The damaging effects of invasive species are particularly pronounced on islands (Veitch et al., 2011), often leading to multiple extinctions of native flora and fauna, many of which are endemic to only one or few islands that have only one or a few local populations. The invasion of alien species, alongside with habitat destruction and resource exploitation, has been blamed for biodiversity loss (Catibog-Sinha & Heaney, 2006).

To minimize the impacts of these invasive species on biodiversity, there should be timely, efficient, and judicious enforcement of laws and regulations; focused research; enhanced multi-sectoral participation; stronger public awareness and involvement; collective action; and better information exchange. These concerns, among others, have to be considered in developing effective policy and institutional measures.

Component 1 of the Global Environment Facility (GEF) project, "Removing Barriers to Invasive Species Management in Production and Protection Forests in Southeast Asia," aims to enhance the capacity of four pilot countries (Cambodia, Indonesia, Philippines, and Vietnam) to manage Invasive Alien Species (IAS), particularly in forest ecosystems, by addressing national policy and institutional frameworks for the prevention and management of IAS. The project is in line with the GEF-4 Biodiversity Strategic Programme 7 (SP-7), Prevention, Control and Management of IAS, which has as its objective "to halt or reverse ecosystem degradation and reduction in biodiversity due to the spread of invasive alien species." The proposed project also supports the GEF Sustainable Forest Management Framework Strategy (GEF IV-SFM). The project will contribute directly to SFM Strategic Objective -"sustainable management and use of forest resources by developing institutional and organizational capacity to build cross-sectoral partnerships."

Furthermore, Article 8(h) of the Convention on Biological Diversity (CBD) states that the Philippines as a Contracting Party should, "as far as possible and appropriate, prevent the

introduction of, control or eradicate those alien species that threaten ecosystems, habitats or species." The Aichi Biodiversity Target 9 of the CBD aims to halt biodiversity loss by 2020 by addressing IAS issues as a matter of global priority. Other international treaties and agreements-such as the Ramsar Convention (formally The Convention of Wetlands) and Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)-have also recognized IAS as an important issue in biodiversity conservation and have been urging Contracting Parties to take actions to prevent, eradicate, and control IAS. In the Fourth National Report to CBD, the Philippines underscores the threat of IAS on biological diversity in terrestrial and freshwater ecosystems in the country.

A multi-stakeholder national conference and workshop on IAS held in 2006 resulted in the adoption of the Marikina Resolution identifying major action areas such as: research and government support, information and education to build public awareness, informational sharing networking, capacity building, and formulation of a national policy and management strategy for IAS. Consequently, a draft NISSAP was prepared, providing the initial step towards a collective action among relevant stakeholders. A proposed action plan to address IAS pathway in hull fouling and ballast water was discussed during the National Consultation Meeting and Seminar on Ratification and Implementation of Ballast Water Management Convention (BWMC).

Thus, the National Invasive Species Strategy and Action Plan (NISSAP) was developed to provide guidance in preventing the introduction and spread of invasive species and to effectively manage their impacts on biodiversity.

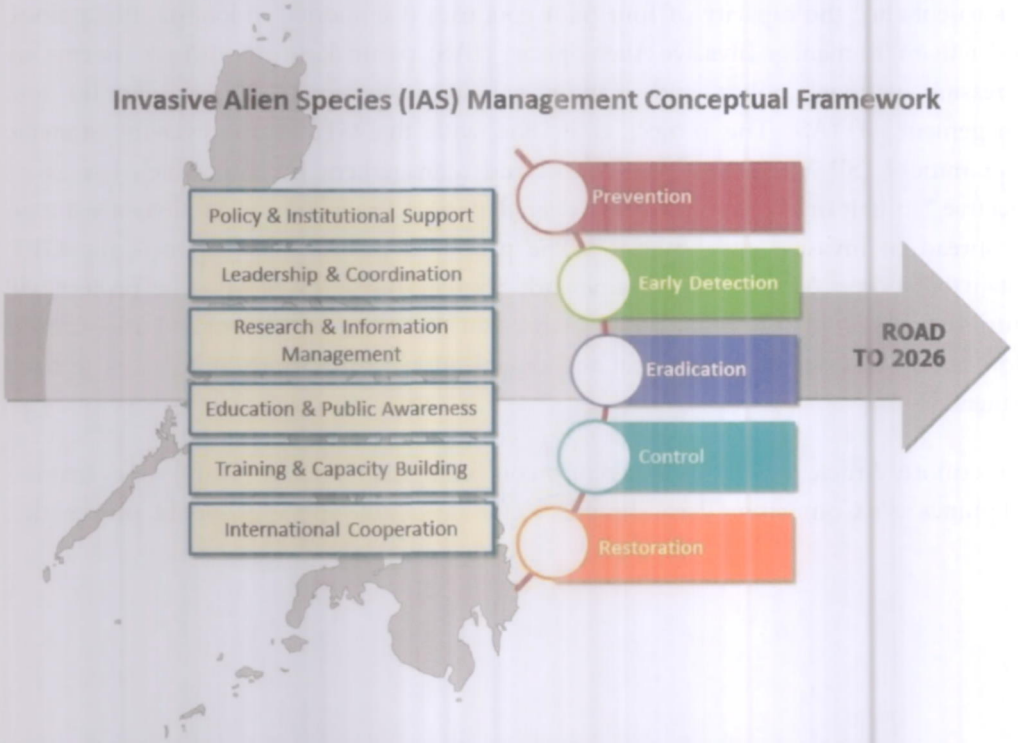

Figure 1.1: Invasive Alien Species (IAS) Management Conceptual Framework, 2016

II Status of Invasive Alien Species

Biological invasions are growing at an alarming rate worldwide. The invasion of alien species, alongside with habitat destruction and resource exploitation, has been blamed for biodiversity loss.

Alien species refers to "a species, subspecies or lower taxon, introduced outside its natural past or present distribution, including any part, gametes, seeds, or propagules of such species that might survive and subsequently reproduce" (CBD, 2002). These organisms are sometimes called "exotic", "non-native" or "nonindigenous". Not all exotic species survive or become established in the new habitat where they were introduced primarily because of the absence of a suitable environment necessary for their survival. Not all exotic species are invasive, and some exotic species have become widespread and "naturalized" without causing much harm to the natural environment. For example, about 225 introduced plant species in the Philippines are found only in cultivation for food, causing no significant environmental harm (Baguinon et al., 2005). However, there are those that survive and establish themselves at the expense of the native species and eventually become invasive.

The Convention on Biological Diversity (CBD) defines invasive alien species (IAS) as exotic species 'whose introduction and/or spread outside of their natural past or present distribution threatens biological diversity' because of their ability to produce viable populations, spread, and colonize natural ecosystems. They can be introduced plants, animals, pathogens and other organisms, which may cause negative effects to the economy, environment and human health. IAS cause problems to the economy by burdening the agricultural, forestry, and fisheries industries. Further, they adversely impact biodiversity by causing the decline or extinction of native species – through competition, predation, or transmission of pathogens, which leads to the decline or elimination of native species – and disrupts local ecosystems and ecosystem functions (CBD, n.d.). Many invasive species are prolific, highly volatile, and tolerant. They are typically resistant to adverse environmental conditions; once established, they can be very difficult to control and often impossible to eradicate. Successful invasion by alien species has already been responsible for many cases of species extinction (Baillie et al., 2004). For example, it accounts for 40% of the extinction of mammals worldwide (Groombridge, 1992). To address this global problem, the CBD directs the contracting parties to mitigate the threats of IAS on biodiversity. Hoping to reduce pressure on biological diversity by 2020, the Aichi Biodiversity Target 9 of the Convention on Biological Diversity (CBD) 2011-2020 Strategic Plan aims to prioritize the identification, control, and eradication of IAS as well as the management of IAS pathways to prevent introduction and establishment.

Given that intentional introduction of exotics to boost food production will continue in our globalized world, it is crucial to have appropriate and coordinated risk assessment for the presence of IAS, pathogens, and diseases. It is also important to assess the risk of new

introduced live plants and animals from becoming invasive and harmful to humans and the environment.

IAS Pathways

The pathways of the introduction of IAS are varied and complex. A pathway refers to the means (e.g., aircraft, water vessel, and train) or commodity (e.g., timber, fruits, and pets) by which an alien species may be transported to a new location, either intentionally or unintentionally. IAS pathways are associated with activities in fisheries, agriculture, forestry and reforestation, trade, travel, and tourism (Catibog-Sinha & Heaney, 2006). Examples of IAS pathways include:

(1) aquaculture escapes or releases,
(2) ballast water,
(3) biological control introductions,
(4) boat hulls,
(5) escaped or released pets,
(6) escaped or released ornamental plants,
(7) government programs and foreign aids,
(8) land or water alterations,
(9) live food industry,
(10) pathogens spread by non-natives to vulnerable native species,
(11) science or laboratory escapes,
(12) seafood packing and disposal,
(13) tourism and travel,
(14) vehicular transportation,
(15) zoos or wildlife rescue center escapers or releases, and
(16) escaped and released captive wildlife.

IAS in marine environment (e.g., zebra mussels, plankton) are carried by ballast water and boat hulls. In inland waters (especially lakes), IAS are introduced from accidental aquaculture escapes (e.g., janitor fish, knife fish) as well as from intentional releases for food production (e.g., Nile tilapia). Ornamental plants (e.g., *Lantana camara*) and pets (e.g., Chinese soft-shelled turtle) may escape from cultivation and captivity and can become feral. In terrestrial ecosystem, introduction of exotic plants to speed up reforestation (e.g., mangium) and reduce soil erosion on grasslands (e.g., kudzu) is a common IAS pathway. Transferring "foreign" soil and disposing solid waste to reclaim and alter land and water ecosystems are also pathways of IAS. The seeds and propagules of IAS can be accidentally and intentionally introduced at airports and harbors. Tourism in protected areas also serves as an easy pathway of IAS, with tourists carrying seeds and viable plant materials in their shoes and backpacks and spreading them on wilderness trails and camping sites. Horses, for instance, that convey tourists to some remote areas can carry noxious weeds and seeds in their hooves. The propensity of nature-based tourists to visit islands adds risk to the vulnerability of islands to IAS.

The speed and extent of IAS introduction depend on several factors and the combinations of these factors, such as types of species and their reproductive, dispersal, and coping abilities; speed and direction of wind and water flow; volume and nature of tourism travel and movement; and prevailing climate and weather conditions.

The movement of IAS in natural forests can be facilitated along forest access roads, wilderness foot trails, fire breaks, and forest fringes especially those close to human settlements and agricultural activities (e.g., shifting cultivation, wilderness recreational tracking, forest resource gathering and harvesting). Natural corridors in terrestrial ecosystems, such as streams and rivers, can introduce and spread IAS in a rapid and wide geographical scale.

Impact of IAS

The adverse consequences of IAS on biodiversity have been increasing over many decades, often in a continuing and very rapid rate, especially on islands, tropical forests, and inland waters (e.g., Millennium Assessment, 2005; Pimentel et al., 2001).

IAS displace existing native species through competition, predation, habitat alteration, diseases, and parasitic infestations. Studies have shown that IAS could alter the evolution of native species by competitive exclusion, niche displacement, predation, and ultimate extinction (Mooney, 2006). In some cases, exotic species have hybridized with closely related species (Szaro & Johnston, 1996) and have transmitted diseases harmful to both plants and animals). For example, hybridization between the feral pig (*Sus scrofa*) and the endangered warty pigs (*Sus cebifrons*) is a threat to the survival of the latter species (Oliver, 1998). Hybridization also occurs when mating between two subspecies or subpopulations takes place, as in case of captive Philippine monkey (*Macaca fascicularis*) from Mindanao and Luzon (Catibog-Sinha & Heaney, 2006). The genetic purity of the captive stock of the Philippine duck (*Anas luzonica*) had been questioned because of "uncontrolled" breeding of the Philippine duck with mallards (*Anas platyrhynchos*) (Collar et al., 1999). All these examples can lead to loss of genetic diversity, which is a major driver of biodiversity loss.

The structure and functions of an ecosystem can be altered dramatically by IAS. Modification of ecosystems by IAS (particularly vascular plants, e.g., *Mimosa pigra*) in Southeast Asian countries can lead to localized loss of biodiversity (Peh, 2010). Large populations of domesticated and/or feral goats and pigs, known for their close-to-ground grazing and uprooting respectively, can alter soil structure and disrupt nutrient cycling (Vitousek et al., 1997). In several cases, introduced exotic species carry with them invasive pests (e.g., arthropods, virus, fungi) that can devastate forestry, agriculture, and aquaculture causing tremendous economic loss and ecosystem degradation. The presence of IAS in ballast water of cargo ships is a growing concern as this has been identified as an important pathway for the introduction and spread of IAS beyond political borders.

The economic cost of IAS globally is around US$1.4 trillion. In the US alone, Pimentel et al. (2001) estimated an annual cost of US$120-137 billion. In Australia, IAS cost at least

AUS$7 billion yearly (CSIRO, 2013); some 25% percent of costs to consumers associated with food products are due to invasive weeds, pests, and diseases. In Southeast Asia, the total annual loss caused by IAS to agriculture, human health and the environment was estimated to be US$33.5 billion of which agriculture had the highest loss of 90% of the total, while the cost to the environment (i.e., feral cats and pigeons) was US$ 2.1 billion (Nghiem et al., 2013). Rice productivity loss in the Philippines from golden apple snails (*Pomacea canaliculata*) was estimated to be US$12.5- 17.8 million (Naylor, 1996). Because of expanding trade and globalization, the introduction of invasive species will further increase as well as the costs associated with preventing introductions and managing new infestations.

The harmful consequences of climate change on all ecosystems, including forests, can be significant (Masters and Norgrove, 2010). Climate change-induced alteration of ecosystems can facilitate the spread of invasive species through creation of habitats and favorable conditions that suit new and already established invasive species. The associated increasing temperature and variability in the amount and distribution of rainfall can result in more frequent forest fires followed by pests and diseases. It is predicted that the effects of global climate change will include invasion by alien species into new areas, and that species formerly regarded as benign may become invasive (Dukes & Mooney, 1999; US-EPA, 2008).

The Vulnerability of Philippine Biodiversity to IAS

While islands make up only 5% of the earth's surface area, they support 20% of all biodiversity, including a disproportionately high level of endemic species. The damaging effects of invasive alien species are particularly pronounced on islands, often leading to multiple extinctions of native flora and fauna, many of which are endemic to only one or few islands and have only one or a few local populations. Introduction of exotic species (e.g., goats, rats, snails, weeds) has affected several native species on islands, as in the case of about 25% threatened birds found in these areas (Baillie et al., 2004). Most of the extinctions of birds, mammals, and reptiles during the last 150 years have occurred on islands, and more than 80% of the endemic plants of some oceanic islands are extinct or in danger of extinction (Groombridge, 1992). Island endemics are extremely vulnerable because they evolve without competitors or enemies and are, therefore, poorly equipped to coexist with such invaders. Island endemics may not have any or few natural predators and may have few defenses against introduced predators. Some do not have natural immunities to introduced pests and diseases (Primack, 1995).

The Philippine archipelago of more than 7,000 islands is one of the most diverse countries in the world. It is home to at least 38,000 animal species, of which at least 35,000 are invertebrates and 3,000 are terrestrial and aquatic vertebrates (NRMC-UP, 1986; DENR/UNEP, 1997; PBCPP, 2002). The latter figure represents about 5% of the total number of vertebrates known globally (57,739 species) – about 5 times as many as would be expected on the basis of the size of the country (Catibog-Sinha & Heaney, 2006). The

estimated number of Philippine plant species ranges from about 14,000 to more than 15,000, representing about 5% of all species globally described so far. The rich Philippine biodiversity is attributed to its high endemicity. Endemism pertains to the restricted distribution of biota at any taxonomic levels, which are unique and found nowhere else in the world. Species endemism in Philippine plants can be as high as 45-60% for flowering plants in primary forests (PBCPP, 2002). Endemicity of Philippine fauna is also high: 66% for terrestrial mammals (Heaney, 2004); 49% for birds (Collar et al., 1999); 66% for reptiles; and 77% for amphibians (Brown et al., 2001; Diesmos et al., 2002 in PBCPP 2002). Of the 349 listed freshwater fish species in Fish Base (2013), some 44 species are introduced to the Philippines; about 120 species are endemic (Froese & Pauly, 2013). At least 39% of all known endemic vertebrates are threatened with extinction (Catibog-Sinha & Heaney, 2006).

The Philippine government had set aside more than 1.5 million hectares of land as watershed forest reserves (DENR-FMB, 2003). The protected areas in the Philippines, under the National Integrated Protected Areas System (NIPAS), represent about 10-12% of the total area of the Philippines. However, even these areas are at risk as some portions of the reserves are denuded by logging and occupied by settlers. Forest depletion in the Philippines since the end of the World War II has intensified due to increasing population, overexploitation of timber and other forest products, and conversion to other land uses. From 2000 to 2005, the Philippines lost 2.1% of its forests every year-the second fastest in Southeast Asia (Echanove, 2008). The conservation potential threat index, based on the study of the remaining forest areas and deforestation rate in the Philippines, indicates that the forests in the entire country are highly threatened (Dinerstein & Wikramanayake, 1993). Studies predicted that the rapid loss of forest vegetation in the Philippines will lead to massive extinction of endemic species if it continues (Brooks et al., 1997; Dinerstein & Wikramanayake, 1993; Myers, 1988).

The destruction of forests often leads to the establishment and spread of IAS. Forest fragmentation creates small and scattered patches of forests leading to higher "edge effect" at the forest fringes, which become easy and attractive pathway for the establishment of IAS. The forest interior, which harbors high level of biodiversity and endemism, becomes vulnerable to species invasion via the entry points along forest fringes and forest gaps (Brothers & Spingarn, 1990).

There are more than 500 wetland sites in the Philippines which are in several stages of degradation (Davies et al., 1997). The impact of introduced species is a major ecological problem in many inland waters (BMB/ARCBC 2001). The introduction of alien species to supplement aquatic-based food resources has contributed to several ecological problems in many lakes and tributaries (Guerrero, 2001). In the early 1970s to 1990s, several exotic species were introduced into natural bodies of water as aquaculture fish. Exotic species can prey on the eggs and fry of native species and bring with them diseases alien to native aquatic fauna (Juliano et al., 1989). Coastal wetlands are generally not well understood and are often mismanaged despite the fact that they are among the richest and most productive

ecosystems in the world. They are also among the most threatened ecosystems (Morton & Blackmore, 2001). IAS can find their way in aquaculture that are carelessly established or maintained in brackish waters and estuaries.

Invasive Alien Species in the Philippines and their Impacts

The introduction of alien or exotic species in the Philippines was both intentional and accidental. Some severely and potentially invasive alien species (plants, insect pests, and other pathogens) in the Philippines are listed, among others, in the Asia-Pacific Invasive Species Network (Pinol et al., 2006), Fishbase (2013), IUCN-ISSG (2005), ISSG-Global Invasion Species Database, 2013), Island Biodiversity, and Lowe et al. (2000).

Many of the past and present introductions are intended for food production, reforestation, horticulture, and recreation. Invasion by alien species in the Philippines is a result of one or any combination of the following factors: (a) transport of organisms to a new habitat – this could be between islands within a country or between countries; (b) establishment and propagation of the alien species in the new habitat–either in natural or manmade habitats, such as enclosures, lakes, reforestation areas, and gardens; and (c) uncontrolled spread from initial population over large area–either through deliberate release or accidental escape.

Invasive alien species have been recently recorded in many inland waters, terrestrial, and coastal ecosystems in the Philippines. The occurrence of species invasions has been observed in protected areas, wetlands, agricultural areas as well as in production and protection forests in the country. However, most of these reports are anecdotal and not scientifically or rigorously studied. Very little is known about the impact of IAS on Philippine native biota. The impact of invasive species on Philippine biodiversity can be very serious; but the extent and intensity of such impacts are generally unknown (Catibog-Sinha & Heaney, 2006).

1. Invasive Alien Plants

A large number of exotic plants have been introduced to the Philippines, see Box 2.1. More than 475 plant species were introduced to the Philippines during prehistoric times mainly from the Malayan region. During the Spanish and American colonization eras, more species were introduced mainly for food production, reforestation of denuded areas, and aesthetic and recreational purposes (Baguinon et al., 2005).

Exotic plant species are found in all types of habitats even in protected areas. A preliminary resource assessment of 12 national parks in the Philippines conducted in 1985 indicated that nearly 50% of the inventoried 'wild-food' plant species were alien, most of which were found at forest fringes and abandoned *kaingin* farms (Catibog-Sinha, 1994).

Examples of the most noxious invasive plants in the Philippines are hagonoy (*Chromolaena odorata*), a fast-growing perennial shrub infesting pastures and plantations (Castillo et al., 2003; Florece, 2001), and *ayam/coronitas* (*Lantana camara*), a bushy plant introduced for ornamental landscaping. Both plants are on the global list of most invasive species in the world (IUCN/ISSG, 2005). Water hyacinth (*Eichornia crassipes*) is also in the top ten most noxious weeds in the world and has invaded many slow-flowing and high eutrophic wetlands in the Philippines. Cogon grass (*Imperata cylindrica*), although considered a naturalized species by some botanists, has seeds that can be easily spread by wind and tends to become more invasive than others; it now covers about 20% of the country. It also burns easily during the dry season, thus, preventing native species from reestablishing in their natural habitats.

Giant salvinia or kariba weed (*Salvinia molesta*) is a water fern that is cultivated as an ornamental plant but has escaped and become a noxious pest in many regions worldwide; found in lakes, ponds, streams, ditches, marshes, and rivers.

The most common reforestation species are exotic and fast-growing, such as bagras (*Eucalyptus deglupta*), gmelina (*Gmelina arborea*), *Acacia auriculaformis*, *Acacia mangium*, and mahogany (*Swietenia macrophylla*) (Uriarte et al., 2007). The dominance of these species in many areas in the country has contributed to some of the changes occurring in the Philippine ecological landscape.

Figure 2.1: *Chromolaena odorata*/Siam weed, *hagonoy*

Figure 2.2: *Lantana camara*/lantana, *coronitas*

Figure 2.3: *Eichhornia crassipes*/water hyacinth

Figure 2.4: *Piper aduncum*/spiked piper, *buyo-buyo*

Figure 2.5: *Spathodea campanulata*/ African tulip

Figure 2.6: *Leucaena leucocephala*/ *ipil-ipil*

Photos by Edwin R. Tadiosa and Danilo N. Tandang.

Box 2.1: Basic information, characteristics and impacts of some invasive alien plants in the Philippines, 2016

***Acacia mangium*/Mangium**
Introduced from Sabah in 1960. It is a fast-growing tree that produces many seeds, and used primarily for forestry and ecological restoration. It is considered a threat to indigenous plants (Baguinon et al.; 2005; CABI, n.d.; ISSG, 2005; Pinol et al., 2006).

***Spathodea campanulata*/African tulip**
Introduced as an ornamental plant and a shade tree. It rapidly invades disturbed areas, abandoned agricultural lands, and native forests, where it forms thickets and out-compete surrounding plants (CABI, n.d.).

***Broussonetia papyrifera*/paper mulberry**
Introduced in 1935 to augment the bast fibre-producing tree crops on Makiling Forestry School campus but escaped to become a serious pest. It invades young secondary forests and retards the natural ecological succession in forest gaps (Baguinon et al., 2005; CABI, n.d.; Pinol et al., 2006).

Piper aduncum*/spiked pepper, *buyo-buyo
It was reported to have been introduced in Zamboanga in the 1960s for the pulp and paper industry, but it was later abandoned because of its poor fiber. It has since invaded Mindanao peninsula and, Samar, Leyte, and Panay Islands. It invades disturbed areas where it is able to form thickets; spreads by sprouts and suckers; disrupts ecological succession and decreases biodiversity (CABI, n.d.; Florece and Colladilla, 2006; ISSG, 2005; MacKinnon, 2002).

Leucaena leucocephala/ipil-ipil
Introduced during the Spanish colonial period for forage, firewood, and reforestation activities. It forms pure stands which are difficult to remove and renders the land unusable. It is a potential habitat transformer; it reduces species diversity, outcompetes endemic and native species, and prevents the regeneration of native forest vegetation. Its mimosine content is toxic at high concentrations to non-ruminant livestock (Joshi, 2006; CABI, n.d.).

Chromolaena odorata*/Siam weed, *hagonoy
It was introduced into the tropical regions of Asia, Africa and the Pacific, where it is an invasive weed. It is an aggressive competitor and may have allelopathic effects; a nuisance weed in agricultural land, pasture land and commercial plantations (Baguinon et al., 2005; CABI,n.d.; ISSG, 2005; Pinol et al., 2006).

Lantana camara*/large-leaf lantana, *coronitas, baho-baho
Introduced as landscape plant; can become the dominant understory species in disturbed forest; disrupts succession and decrease biodiversity; its allelopathic qualities can reduce vigor of nearby plant species and reduce productivity in orchards (Baguinon et al., 2005; CABI, n.d., ISSG, 2005; Pinol et al., 2006).

***Mikania micrantha*/mile-a-minute weed, uoko**
A fast-growing vine originally from Central and South America. It was introduced as an ornamental plant, a cover crop for plantations, and airfield camouflage during the World War II. It is now considered as a major weed of various crops. It competes with the light, water and nutrient requirements of other plants; it smother other plants around it, and releases chemicals that prevents its competitors from growing (Joshi, 2006; CABI, n.d.).

***Salvinia molesta*/water fern**
Introduced for ornamental purposes; discovered in late 1970s in Panay Island where rice fields were invaded; can form dense vegetation mats that reduce water-flow and lower the light and oxygen levels in the water; negatively affects biodiversity and abundance of freshwater species including fish and submerged aquatic plants (CABI, n.d., ISSG, 2005).

***Eichhornia crassipes*/water hyacinth**
Introduced for ornamental purposes; causes heavy damage on the fish pens and cages; undesirable in fishing and aquaculture activities in many major lakes in the country; blocks waterways, limits boat traffic and navigation and recreational activities; prevents sunlight and oxygen from reaching the water column and submerged plants; shades and crowds native aquatic plants leading to reduced biological diversity in aquatic ecosystems (Baguinon et al., 2005; CABI, n.d., Pinol et al., 2006).

2. Invasive Alien Terrestrial Vertebrates

To enhance the Filipino diet with animal protein as well as to supplement the meager income of lowland farmers, exotic animals have been introduced to the Philippines. Box 2.2 lists some of the invasive terrestrial vertebrates introduced in the Philippines. The American bullfrog (*Rana catesbeiana*) was imported in the late 1960s for frog farming. While it was reported to have spread after escaping from enclosures, the frog seems to have died out.

Other notorious non-native and invasive terrestrial animals in the Philippines includes the Central American cane toad *(Rhinella marina)*. The Chinese tiger frog (*Hoplobatrachus rugulosus)*, which was introduced from Taiwan about 25 years ago, is spreading throughout the country at an alarming rate (Diesmos et al., 2006). It is believed that *Mus musculus* (house mouse), *Rattus tanezumi* (Oriental house rat), and *Rattus exulans* (ricefield rat) were introduced accidentally from the Asian mainland (Heaney & Regalado, 1998). These exotic rats have caused heavy damage to agriculture, human dwellings, and native habitats. Goats are exotic species that were deliberately introduced and now inflict significant damage to native vegetation in some areas.

Figure 2.7: *Hylarana erythraea*/ green paddy frog (Source: Arvin C. Diesmos)

Figure 2.8: *Rattus tanezumi*/ Oriental house rat (Source: Maria Josefa S. Veluz and Arvin C. Diesmos)

Figure 2.9: *Pelodiscus sinensis*/ Chinese softshell turtle (Source: Emerson Y. Sy)

Figure 2.10: *Callosciurus finlaysonii*/ variable squirrel (Source: Pola Geneva A. Bumanglad.)

Box 2.2: Basic information, characteristics and impacts of some invasive alien terrestrial vertebrates in the Philippines, 2016

Rhinella marina/cane toad
Introduced to the Philippines in 1934 as a biological control agent of sugarcane insect pests, the cane toad has become a pest itself. It feeds largely on invertebrates and competes with native amphibians for food and breeding habitats. It is the most widely distributed alien frog in the Philippines. It typically inhabits second-growth vegetation, forest plantation, agricultural plantation, natural and artificial ponds and lakes, and built-up areas (CABI, n.d.; ISSG, 2005; Diesmos, et al., 2006, 2008).

Hylarana erythraea/green paddy frog
Reportedly native to Borneo, it is common in natural and artificial lakes and ponds and human-modified areas. Its ability to invade natural forests has tremendous implications for amphibian conservation in the Philippines.

Hoplobatrachus rugulosus/Chinese tiger frog
It is a potentially harmful invasive species because of its ability to penetrate and breed in natural forest and have a high population density. It threatens native fauna through competition (with sympatric endemic frogs) and predation (of native and endemic fauna) (CABI, n.d.; Diesmos, et al., 2006, 2008).

Eleutherodactylus planirostris/greenhouse frog
The Greenhouse frog has only been recently introduced in the Philippines; it was suspected to have been introduced through imported ornamental plants and landscape materials. It is considered invasive in other countries because it competes with other native species for food, and is a food source of nonnative and invasive species itself. They also prey on native invertebrates, some of which are threatened (Sy et al., 2015; GISD, 2016; Somma, 2016).

Trachemys scripta elegans/red-eared slider
It has been the most popular turtle in the pet trade with more than 52 million individuals exported from the United States to foreign markets between 1989 and 1997. Despite its worldwide introduction, little is known of its impact on indigenous ecosystems and native fauna. The omnivorous diet and ability to adapt to various habitats gives this species great potential for impacting indigenous habitats. It is nominated in the top 100 worst invasive species in the world, where impacts have been identified particularly in Europe (CABI, n.d.; ISSG, 2005).

Pelodiscus sinensis/Chinese softshell turtle
It was introduced to the Philippines through the food trade but was released or escaped from confinement. It now causes damage to wetlands and aquaculture farms (CABI, n.d., Sy, et al., 2004).

Mus musculus/house mouse
Has a world distribution more extensive than any mammal, apart from humans. It destroys crops and consumes and/or contaminates food supplies intended for human consumption. It is a prolific breeder, sometimes erupting and reaching plague proportions. It has been implicated in the extinction of indigenous species in ecosystems they have invaded (CABI, n.d.).

Rattus exulans/ricefield rat
The Pacific rat may have originated from mainland Asia and arrived the country through human means; maybe a prehistoric introduction. It is often encountered in forests and recognized as a predator of native insects, lizards, and birds. It is also a browser of native flora and considered an agricultural pest (Alcala, 2006; Diesmos et al., 2006, 2008).

Rattus tanezumi/Oriental house rat
It is a major rodent pest introduced via boats docking at various seaports. It is commensal and invasive and can be found encroaching in early second growth forest (CABI, n.d.).

Callosciurus finlaysonii /variable squirrel
It is an arboreal and nocturnal tree squirrel native to central Indochina. It can tolerate some degree of habitat modifications. In the Philippines, it probably escaped from pet shops/owners and it is now a new pest spreading in metropolitan Manila. It feeds on fruits and seeds in orchards, parks areas, and garden; found in electric wires and wooden structures. In Europe, the most evident damage is bark stripping that can be severe and may significantly impact trees and timber plantations; it is known to feed on bird eggs (CABI n.d.).

3. Invasive Alien Freshwater Fish

While aquaculture projects in the Philippines aim to increase food production and improve local livelihoods, BFAR acknowledges that "aquaculture potentially has several adverse effects on wild species, including disease transmission, escape, and capture for broodstock or rearing, among others" (BFAR-PHILMINAQ, 2007, p.12). Information about the introduction of freshwater fish species in natural wetlands and its impact on biodiversity in the Philippines is limited.

Some 169 exotic aquatic fish species have been introduced into inland waters in the Philippines since 1907 (Cagauan, 2007). More than 82% of the introduced species in aquaculture have established viable populations in the wild (Casal et al., 2007), see Box 2.3. Juliano, et al. (1989) and Guerrero (2001, 2002) gave a brief account of the impact of introduced species on several lakes in the Philippines. Their reports indicate that the edible catfish from Thailand (*Clarias batrachus)* has displaced the much tastier native catfish (*Clarias macrocephalus*). The molly fish (*Mollienesia latipinna*), introduced initially to control mosquitoes, was found to prey not only on malaria-carrying mosquitoes but also on other native but economically beneficial insects. Since their introduction in the 1970s, the common carp *(Cyprinus carpio*) and Nile tilapia (*Oreochromis niloticus)* have been a major source of food-fish in the Philippines. These introduced species have been blamed, however, for the displacement of several native species, predation on eggs and fry of native fish, and possibly the introduction of alien pathogens (Juliano et al., 1989). It has been reported that the success of tilapia introduction for aquaculture may be one of the major causes of the disappearance of *sinarapan* (*Mistichthys luzonensis),* the world's smallest, economically important fish found only in Lake Buhi (Alejandro et al., 1994).

The introduced aquarium catfish (*Hypostomus plecostomus*), commonly known as "janitor fish" because of its ability to keep fish tanks free from algal growth, was accidentally released in Laguna de Bay and has been causing damage to fishnets and might be competing with more valuable fish (LLDA, 2005). The presence of janitor fish (*Pterygoplichthys disjunctivus)* in Agusan Marsh and its tributaries was also reported (Hubilla et al., 2007). Lately, the invasion of an exotic knife fish (*Chitala ornata*), an ornamental fish that was accidentally released in Laguna de Bay, is causing tremendous impact on local livelihoods. As the knife fish is a voracious carnivore and has no natural predators, it has disrupted the natural food chain and has been blamed for the population decline of native and more valuable fish species in the lake.

Some protected areas are not free from the impact of IAS. In Naujan Lake National Park, introduced tilapia (*Oreochromis niloticus*) is believed to have displaced the previously abundant native fish species (e.g., mullet/ *banak-Liza froscheli*). In the inland wetlands of Mt. Isarog Natural Park, exotic invasive species (e.g., *tilapia, hito*) have displaced the endemic species (e.g., *talusog, kauli*) based on the declining annual catch data from 1988 to 2002 (Bradecina, 2007).

Box 2.3: Basic information, characteristics and impacts of some invasive alien fish in the Philippines, 2016

***Cyprinus carpio*/ Thai catfish, walking catfish**

Introduced in the Philippines in 1972 from Thailand for commercial aquaculture, but was not successful because of its tough flesh. It is now widely distributed in the Philippines, inhabiting swamps, ponds, ditches, rice paddies, and pools left in low spots after rivers have been flooded. It is blamed for the displacement of the native catfish (***Clarias macrocephalus***) in Luzon. It is also considered as pest in tilapia ponds. (ISSG, 2005; CABI, n.d.; Casal et al., 2007; Guererro, 2002, 2006).

***Cyprinus carpio*/common carp**

The first carp to be introduced in the Philippines in 1910 from Hong Kong and China for commercial aquaculture. It vigorously agitates the sediments on the bottom of the lake/pond and uproots macrophytes; alters the habitats of native fish and other native aquatic species (ISSG, 2005; CABI, n.d.; Casal et al., 2007; Guererro, 2002, 2006).

***Gambusa affinis*/mosquito fish**

Introduced from Hawaii in 1905 primarily for mosquito and malaria control. It is abundant in canals, rice fields, and other water bodies. This highly predatory fish eats the eggs of economically desirable fish and preys on and endangers rare indigenous fish and invertebrates (ISSG, 2005; Casal et al., 2007; Guererro, 2002, 2006).

***Oreochromis niloticus*/Nile tilapia**

Introduced for commercial aquaculture. It is omnivorous and highly invasive, causing a variety of disturbances in freshwater ecosystems, particularly those located in the tropics. Its mouth brooding reproductive strategy allows it to increase in numbers at a rate, which not only crowds native species, but pollutes and unbalances the water column (ISSG, 2005; CABI, n.d.; Casal et al., 2007; Guererro, 2002, 2006).

***Parachromis managuensis*/jaguar guapote**

Introduced in the Philippines as an aquarium fish and then escaped/released into Taal Lake in the early 1990s where it has established and become invasive. It feeds on small fishes and macro-invertebrates. It is also believed that to have displaced and preyed on native species (CABI, n.d.; Guerrero, 2002, 2006; Agasen, et al., 2006).

***Pterygoplichthys* spp./janitor fish**

The species under this genus includes *Pterygoplichthys disjunctivus (Liposarcus disjunctivus,* Vermiculated sailfin catfish) and *Pterygoplichthys pardalis* (*Hypostomus pardalis,* Amazon sailfin catfish). They have become invasive in the Marikina River (Metro Manila), Lake Paitan in Cuyapo, Nueva Ecija, and Laguna de Bay. They were accidentally and/or purposely released into natural waters. With no natural predators, the species can multiply fast, out-competing the native fish and other freshwater organisms for food and habitat. Its burrowing behavior in river banks may contribute to water turbidity and soil erosion. It also destroys fishing gears (ISSG, 2005; CABI, n.d.; LLDA, 2005).

Figure 2.11: *Hypostomus plecostomus*/janitor fish. (Source: Don T. Dumale)

Figure 2.12: *Oreochromis niloticus*/Nile tilapia (Source: Don T. Dumale)

4. Invasive Alien Invertebrates

There are many examples of invasive invertebrates introduced to the Philippines, see Box 2.4. Brown house-ant (*Pheidole megacephala*) is one of the world's worst invasive ant species. Believed to be native to southern Africa, it is now found throughout the temperate and tropical zones of the world. It is a serious threat to biodiversity through the displacement of native invertebrate fauna. It is agricultural pest as it harvests seeds and harbors phytophagous insects that reduce crop productivity. In the Philippines, it was observed hauling rice seeds to the uplands.

The giant earthworm (*Pheretima spp.*) has been reported to destroy the walls of the rice terraces walls in Banaue (Mt. Province) by burrowing holes resulting in water stress and weed growth, In early 1980s, the golden apple snail (*Pomacea canaliculata*) was introduced without prior testing for palatability and acceptability as an alternative protein source. As a result, the venture proved unprofitable, and culture ponds were abandoned or the captive snails deliberately released into natural waterways. Since then, the species has dispersed and proliferated in many parts of the country, causing considerable damage to wetlands and rice fields.

The spread of IAS in marine waters from ballast water and their impact on economy and marine biodiversity has been recognized in the Ballast Water Convention. The presence of an alien copepod (*Arctodiaptomus dorsalis*) in several lakes in the Philippines (e.g., Laguna de Bay) is suspected to be the cause of the decline of several native copepods in areas where it was introduced either through ballast water or with the release of some aquaculture fish (e.g., tilapia) (Papa et al., 2012). White-spotted jellyfish (*Phyllorhiza punctata*), which might have been introduced into Philippines waters through ballast water, threatens commercial fisheries by feeding on the eggs and larvae of fish, crabs and shrimps and damages fishing nets and gears.

Figure 2.13: *Achatina fulica*/giant African snail
(Source: Vivian D. Ang.

Figure 2.14: *Pomacea canaliculata*/golden apple snail
(Source: Vivian D. Ang.

Figure 2.15: *Monomorium floricola*/bicolored trailing ant
(Source: Perry Archival C. Buenavente.)

Figure 2.16: Tetramorium bicarinatum/penny ant
(Source: Perry Archival C. Buenavente.)

5. Invasive Pests, Parasites, and Pathogens

Infections by disease organisms are common in both wild and captive populations, see Box 2.4 for a partial list. If one animal becomes infected, the parasite can rapidly spread through the population. Parasites are either micro-parasites (e.g., virus, bacteria) or macro-parasites (e.g., worms, insects). A total of 455 major arthropod pests in the 19 countries comprising Southeast Asia had been recorded (Waterhouse, 1993).

One hundred fifty (150) species are rated highly important, out of which at least 24 are believed to be exotic to the Region and are potential targets for biological control. Some insect pests, suspected to have been accidentally introduced into forest plantations in the Philippines, include the Shoot borer (*Hypsipyla robusta*) on mahogany, Varicose borer on bagras (*Agrilus exsignatus*), and Leaf skeletonizer (*Hyblaea puera*) on teak (San Valentin, 2001).

It is unknown if these pests have also infected native plant species. The study of insect pests in Philippine agriculture has been exhaustive, but it is mostly done in the context of pest control to sustain agricultural production rather than to address the impact of IAS on biodiversity. With the emerging interest in agro-biodiversity, more studies of the impact of introduced pests on the ecological integrity of farms will be useful. A similar trend is also becoming evident in agroforestry, which when improperly managed, can be a serious pathway of invasive species into the forest interior.

Box 2.4: Basic information, characteristics and impacts of some invasive alien invertebrates, pests and pathogens introduced to the Philippines, 2016

***Achatina fulica*/giant African snail**

It is a major invasive species that feeds voraciously on a wide variety of crop plants and may present a threat to local flora. Populations of this pest often crash over time 20 to 60 years (ISSG, 2005; CABI, n.d.).

***Pomacea canaliculata*/golden apple snail**

Introduced to the Philippines in 1962 for food and aquaria. In the 1980s, the economic damage to rice crop in the Philippines was estimated to be US$ 1B. It has been implicated in the decline of the population of the native snail *Pila conica* (formerly *Pila luzonica*). It is a vector of rat lungworm parasite, *Angiostrongylus cantonensis* that causes eosinophilic meningoencephalitis when ingested by humans. It is globally considered as one of the 100 World's worst invasive species (ISSG, 2005; CABI, n.d Joshi, 2011; Lowe, et al., 2000).

***Nipaecoccus nipae*/buff coconut mealy bug**

This species of mealy bug has been invasive for the last 5-10 years, infesting coconuts, bananas and other economically important crops and forest species (CABI, n.d.; Joshi, 2011).

***Pheidole megacephala*/big-headed ant, Brown house-ant**

It is one of the world's worst invasive ant species. Probably native to southern Africa. It is a serious threat to biodiversity through the displacement of native invertebrate fauna. It harbors phytophagous insects that reduce crop productivity, and is known to chew on and damage irrigation and telephone cabling and electrical wires (ISSG, 2005; CABI, n.d.; Joshi, 2011; Cuaterno, 2006).

***Paratrechina longicornis*/crazy ant**

Widely dispersed through commerce and other human activities, it occurs in large numbers in homes or outdoors. It is capable of displacing other ants and possibly other invertebrates. It is highly adaptable to various environments and can be a major pest. It forages over long distances away from its nest, making the nest hard to find and the ants difficult to control (CABI, n.d.).

***Pheretima* spp./giant earthworm**

It destroys the walls of the rice terraces in Banaue (Mt. Province) by burrowing holes resulting in water stress and weed growth, hence, affecting rice production The other invasive earthworms reported elsewhere are: *Pontoscolex corethrurus* (origin Brazil), *Polypheretima elongata* (origin SE Asia, probably Indonesian region), *Amynthas corticis* (origin mainland E Asia), *Dichogaster saliens* (origin Africa), *Nematogenia occidentalis* (origin unclear), *Perionyx excavates* (origin: India) (Joshi, 2011).

***Scotinophara coarctata*/rice black bug (RBB)**

A major rice pest that was first reported in the rice fields in southern Palawan in 1979. It spread to other parts of Palawan and Mindanao in 1992 and the Visayas region in 1998. It spread again to Mindanao in 2000 and in the Visayas region in 2001, and later in the Bicol region. It inhabits both rain-fed and irrigated wetland environments, but it is not common in upland rice ecosystem. It is attracted to high-intensity light and produces an offensive odor when disturbed (Joshi, 2011; Cuaterno, 2006).

***Globodera rostochlensis*/potato cyst nematode**

Accidentally introduced with the importation of potato planting materials. It has heavily infested the potato farms in the province of Benguet, in Northern Philippines (CABI, n.d.; Joshi, 2011).

***Phyllorhiza punctate*/white-spotted jellyfish**

Threatens large commercial fisheries by feeding on the eggs and larvae of fish, crabs and shrimps; clogging fishing nets; damaging boat intakes and fishing gear; and causes the closure of productive areas to fishing activities. It might have been introduced into Philippine waters through ballast water (ISSG, 2005).

Psittacine beak and feather disease virus

The causal agent of Beak and Feather Disease (BFD) - one of the most commonly recognized viral diseases of wild psittacine birds worldwide is characterized by chronic, progressive, symmetrical feather dystrophy and occasional beak deformity (ISSG, 2005).

III NISSAP Framework

Vision

The rich and unique biodiversity of the Philippines - especially in forests, National Integrated Protected Areas System (NIPAS) sites, critical habitats, and areas of high conservation value - is protected from the adverse impacts of invasive alien species.

Mission

To contribute to the global effort to halt the rapid rate of biodiversity loss and to address the environmental, health, social, and economic problems associated with the introduction and spread of Invasive Alien Species (IAS) in the country.

NISSAP and Its Implementing Guidelines

It is envisioned that NISSAP will cover the management of various types of IAS, such as vertebrates and invertebrates, weeds, marine and freshwater plants and animals in areas that are most vulnerable to the impact of IAS. By developing and implementing the NISSAP, the Philippine Government hopes not only to prevent the introduction of invasive species but also to effectively manage the spread of invasive species and minimize their threats. The NISSAP provides a framework for coordinated and multi-sectoral management of IAS. It aims to foster cooperation among relevant government and non-government organizations, industries, local communities, civil society, and other stakeholders for a collective and coordinated action. It sets clear priorities for the identification of gaps and inconsistencies in the national and institutional frameworks relating to IAS and providing opportunities to integrate them in the country's commitments to CBD and other international treaties and agreements. However, financial, technical, and scientific capacities have to be developed and strengthened to ensure the efficient and effective implementation of NISSAP and the IAS components of PBSAP.

The NISSAP enumerates all the sectoral concerns and issues about IAS and developed courses of action based on the strategic goals and implementing guidelines.

Thus, implementation of the NISSAP should be able to:

1. Harmonize objectives and scope;
2. Standardize terminologies;
3. Implement measures to:
   a. prevent IAS introductions,
   b. detect and respond early to IAS introductions,
   c. control and manage IAS impacts, and
   d. restore or rehabilitate areas to prevent re-invasion or new introductions;
4. Improve resource capacities through training and research;

5. Manage a collaborative and accessible data-sharing system;
6. Increase public education and awareness;
7. Strengthen international cooperation; and
8. Promote compliance and accountability.

Overall Guiding Principles of NISSAP

The drafting and implementation of NISSAP have the following overall guiding principles:

A. Biodiversity Conservation

The timely and appropriate prevention, control and management of IAS can help reduce the rate of biodiversity loss, especially on islands and areas with high level of vulnerability and species endemicity.

B. Precautionary Principle

The lack or absence of scientific certainty about the various implications of species invasion should not be used as a reason for postponing or failing to take appropriate IAS management measures.

C. Participatory and Consultative Approach To Planning, Decision-Making and Management

The involvement of all stakeholders, such as the indigenous and local communities, academe, private sector, civil society, and various levels of governments, in all aspects of IAS management, is necessary and should, therefore, be encouraged and facilitated.

D. Policy and Institutional Development

Policy, regulatory, and institutional frameworks should be developed collectively by relevant agencies/entities, with clearly defined responsibilities and accountabilities, to ensure that IAS management addresses the ecological, social, and economic implications and consequences of species invasion.

E. International Cooperation

Collaborative efforts between countries (especially trading partners and those with similar ecosystems and histories of invasion), should be strengthened, whether on a bilateral or multilateral basis, to address the risk and impacts of IAS within and across national/territorial borders.

F. Research and Monitoring

Basic and applied research on invasive alien species, including their taxonomy, biology and ecology as well as the causes of invasion and the risks associated with IAS, are essential in supporting IAS policy development and management decisions and actions.

G. Public Education and Awareness

Promoting a broad and deep understanding about IAS among the general public, including decision makers and field implementers, is crucial in addressing IAS issues and problems.

H. Data Sharing and Collaboration

The development of information systems as well as maintaining an effective and accessible network of databases on IAS for use in the context of any prevention, introduction, monitoring and mitigation activities are essential.

I. Training and Capacity Building

Existing relevant governmental agencies and stakeholders should be strengthened and broadened as necessary, and staff should be properly trained towards the implementation of NISSAP.

J. Committed Funding for the Implementation of NISSAP

Adequate and timely release of public funds for the implementation of NISSAP should be sustained. New and additional funding mechanism should be developed to supplement the funding requirements.

Strategic Goals, Objectives, and Action Plans

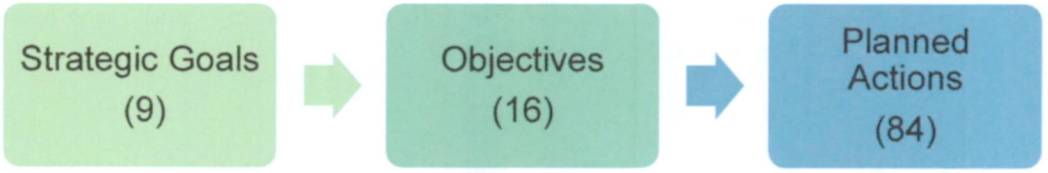

Figure 3.1: Chain of Strategic Goals, Objectives, and Planned Actions, 2016

To determine if the goals objectives and the proposed actions are met, measurable outcomes are listed to serve as the basis for monitoring and evaluation. Systematic monitoring and evaluation will be conducted at the end of each timeline to assess performance and to provide opportunities to determine constraints and make necessary changes to planned actions as an adaptive process in responsive management for biodiversity conservation.

The final version of the NISSAP will be implemented by virtue of an Executive Order, directing relevant government entities to implement the goals of the Plan within the target period and to allocate adequate budget on a timely and regular basis for its efficient implementation.

Strategic Goal 1 – Leadership and Coordination

A. Implementing Guidelines

- Leadership and coordination in the implementation of NISSAP should be considered through a legal framework and implementing rules and regulations.
- The national IAS – implementing body should be empowered through the provision of financial, human and technical support.
- A multi-sectoral approach to IAS management will minimize fragmentation, inconsistencies and weaknesses in legislative compliance and enforcement.
- IAS issues should be integrated into the legislative, planning and management processes in all relevant government sectors.
- A consultative and participatory process will be applied in addressing IAS-relevant matters at the local and government sectors.
- National funding should be committed for short- and long-term implementation of IAS management.

The Department of Environment and Natural Resources, through the Biodiversity Management Bureau, shall facilitate the creation of a National IAS Coordinating Body that will ensure that the objectives and planned actions of the NISSAP are implemented timely, efficiently and effectively. The Body will be tasked to develop an oversight mechanism that is participatory, transparent and democratic. It will ensure that the national policies and operational procedures on the prevention, control and management of IAS are in place. It will also initiate the development of new and up-to-date enabling policies and regulations relating to IAS management. The Body shall be composed of all the agencies identified during the stakeholders' consultations as defined in Table 3.1.

A Technical Working Group (TWG) shall also be created to provide support to the National IAS Coordinating Body. It shall be composed of representatives from the agencies representing the National IAS Coordinating Body, as well as members from the academe, NGO and/or civic groups. The TWG will oversee the review and monitoring of IAS-related activities and provide appropriate recommendations. It will likewise provide up-to-date scientific and technical advice on all matters including resolving conflicts on the management of IAS.

Table 3.1: Philippine national government bodies that have relevant roles and functions on Invasive Alien Species (IAS), 2016

Name of Organization	Key Responsibilities
Department of Environment and Natural Resources (DENR)	The primary government body responsible for the conservation, management and sustainable use of the country's environment and natural resources, including protected areas, forest land, watersheds, public lands, and ancestral domains. The bureaus relevant to IAS are BMB, FMB, EMB, ERDB
a. Biodiversity Management Bureau (BMB)	Develops policies, plans and programs in the conservation of biodiversity through integrated protected area management, conservation and sustainable use of wildlife and protection of their habitats, sustainable tourism, nature conservation and information and public education
b. Forest Management Bureau (FMB)	Develops policies, plans and programs in the protection, development and management of mangroves, upland forest lands, grazing lands and watershed and the reforestation/rehabilitation of degraded areas
c. Environmental Management Bureau (EMB)	Develops policies, plans and programs in the management of environmental quality through clean air and water management, solid waste management and implementation of the Environmental Impact Assessment system
d. Ecosystems Research and Development Bureau (ERDB)	Develops and conducts research and development projects/programs focusing on five major ecosystems in the Philippines, namely : forests, upland farms, grassland and degraded areas, coastal zones and freshwater and urban areas
Department of Agriculture (DA)	The primary government body responsible for the promotion of agricultural and fisheries development and economic growth by providing support services necessary to make agriculture, fisheries and agri-based enterprises accessible and profitable to rural communities
a. Bureau of Fisheries and Aquatic Resources (BFAR)	Develops policies, plans and programs in the management and conservation of the country's fisheries and aquatic resources, including the implementation of quarantine policies for fish and fish products
b. Bureau of Plant Industry (BPI)	Develops policies, plans and programs in the management and protection of agricultural crops from pests and diseases, including the implementation of quarantine policies for the prevention, control and eradication of pests, diseases and injuries to plants and plant products
c. Bureau of Animal Industry (BAI)	Recommends plans and programs, policies and regulations in the prevention, control and eradication of animal diseases; prescribes standards for quality in the manufacture, importation, labeling, advertising, distribution and sale of livestock, poultry and allied industries; coordinates and monitors activities and projects related to livestock and allied industries

The DENR Regional Field Offices shall also facilitate the creation of a mirror image of the National IAS Coordinating Body, to be called Regional IAS Coordinating Body, involving relevant regional offices and stakeholders. They shall assist in the dissemination of information and education materials, and provide

guidance in the implementation of the NISSAP at the regional level. Activities on IAS-related research and management shall be included in the annual budgetary proposals of the regions for funding to be appropriated accordingly.

A two-pronged approach to creating the National IAS Coordinating Body will be pursued. First approach (Objective 1) is to capacitate national and field offices relevant to IAS management, as well as strengthening existing management committees i.e., National Wildlife Management Committee (NWMC), National Plant Committee (NPC) in responding to issues of IAS. The Second approach (Objective 2) shall be initiated in tandem with Objective 1, in recognizing the protracted time and process involved in having an Administrative Order or an Executive Order signed. The foreseen outcome is Objective 2 that will repeal Objective 1 when an Administrative Order or Executive Order (EO) has been signed.

B. Objectives and Action Plan

During the workshops and consultations in the development of the NISSAP, there were two objectives identified to realize the first strategic goal of Leadership and Coordination.

> Objective 1: To streamline/integrate IAS management concerns within existing committees already established through an Administrative Order;
>
> Objective 2: To create a national IAS coordinating body by virtue of an Administrative Order.

Given these objectives, there were action plans identified to be pursued over a target timeline with the lead and participating organizations as shown in Appendix 1.

Strategic Goal 2 – Prevention

A. Implementing Guidelines

- The introduction of alien species including pathogens that can potentially result in biodiversity loss and injury to economic stability, food security, and human health should be prohibited.
- Preventing the introduction of invasive alien species, as the first line of defense, is the most cost-effective method.
- Preventive measures against new introduction of IAS should be provided for in national and local government policies and legislations.
- Efforts to prevent introductions of IAS should be based on the precautionary principle.
- Intentional introductions should only be allowed after a thorough risk assessment and/or if experiences elsewhere prove that such introductions have no significant risk.

- Measures to minimize the impact of climate change complement the IAS

The most effective way to manage IAS is to prevent their introduction and initial incursion. Preventing the entry of IAS is the most cost-effective strategy in dealing with invasive species (Wittenberg and Cock, 2001). With prevention, the adverse long term impacts of IAS on economy, environment and society can be avoided.

As the first line of defense against IAS, prevention should include the identification and assessment of newly introduced species that are likely to become invasive. The rule of thumb in predicting the invasiveness of a certain species/taxa that may be unknown in one location is their reported invasiveness elsewhere. IAS pathway (e.g., aquaculture, tourism, trade, etc.) analysis is also a fundamental tool in determining the likelihood of any intentional or unintentional introduction of IAS. For unintentional introduction, common IAS pathways should be identified and controlled through appropriate mechanisms.

Effective barriers to prevent IAS entry and establishment include quarantine regulations, risk assessment and other biosafety measures. The natural barrier to prevent the introduction of IAS in protected areas is to simply protect and maintain the high biodiversity status of these areas. Studies of small mammals in Northern Philippines (e.g., Mt. Isarog, Zambales mountains) have shown that intact forests and diversity of native small mammals limit the spread of non-native species; in mature forests, native species exhibit more competitive superiority over non-native species (Rickart et al., 2011).

The use of a variety of native species, vines and understory trees at buffer zones around protected areas can provide a vegetation structure less permeable to invasion of wind-dispersed weeds (Cadenasso and Pickett, 2001). It was observed that intact forest edge serves as a functional barrier to the flux of seeds of invasive species from the surrounding landscape into the forest interior.

A national list of invasive species known within the port of entry or elsewhere (especially in neighboring countries and in biologically isolated islands within the Philippines) and those that have the potential to be invasive and harmful is a crucial guide in preventing IAS introduction. This list can serve as an "alert checklist", which quarantine inspectors can refer to before accepting/rejecting plants or animals at ports of entry. The list should also include data, if available, on the biology and ecology of IAS pathways. Furthermore, a site-specific list (e.g., islands, provincial) of IAS and their occurrence in the Philippines is important. This is to help ensure that species that are endemic to an island or locality within the Philippines is not carelessly introduced into another.

Legislative measures that prohibit the introduction of potentially invasive exotic species, especially in protected areas and ecologically critical habitats, are powerful preventive measures when judiciously implemented. There are relevant legal

instruments that prohibit/prevent exotic species that may be potentially invasive as discussed in Annex 3. However, before the passage of these laws, a number of IAS were intentionally introduced to the country, usually with government support. Some were used for reforestation, augmentation of the bast fiber-producing tree crops, biological control of pests, commercial aquaculture and food, as shown in Table 3.2. Some of these introductions have had adverse environmental, health and economic consequences.

Table 3.2: Invasive Alien Species (IAS) introduced in the Philippines prior to legislated preventive measures, 2016

Name of Species Common Name	Life Form	Year of Initial Introduction	Origin	Primary Purpose
Acacia mangium mangium	Tree	1960	Sabah	Reforestation
Broussonetia papyrifera paper mulberry	Tree	1935	Taiwan and Japan	Augmenting the bast fiber-producing tree crops
Eucalyptus spp bagras	Tree	1851-1947		Reforestation
Leucaena leucocephala ipil-ipil	Tree	1910	Central America	Reforestation, animal fodder
Gmelina arborea yemane	Tree	1960	unknown	Reforestation
Swietenia macrophylla large leaf mahogany	Tree	1907	Tropical America	Reforestation
Rhinella marina cane toad	Frog	1934	Central and South America	Biological control agent of sugarcane insect pests
Hoplobatrachus rugulosus Chinese tiger frog	Frog	1966	Borneo	Food
Clarias batrachus Thai catfish, walking catfish	Fish	1972	Thailand	Commercial aquaculture
Cyprinus carpio common carp	Fish	1910	China and Hong Kong	Commercial aquaculture
Gambusia affinis mosquito fish	Fish	1905, 2013	Hawaii	Control of malaria and dengue–carrying mosquitoes
Oreochromis spp (several) tilapia	Fish	1970-1990	Africa, Middle East	Food
Parachromis managuensis jaguar guapote	Fish	1990s	Central America	Aquarium fish
Pomacea canaliculata golden apple snail	Mollusk	1962	Taiwan, USA, Argentina	Food

References: Baguinon et al., 2005; Casal, 2006; Diesmos et al., 2006; ISSG-GISD, 2012.

Annex 4 lists the activities in the various sectors that are required to conduct environmental impact study/assessment, as provided for in the respective policies and Implementing Rules and Regulations (IRR) instruments. The Environmental Impact System (EIS) and compliance requirements should, however, include the submission of an invasive species management plan.

There are also ways to strengthen the EIS system in the prevention of IAS introduction, release and propagation. These include:

- Strengthening the implementation of the EIS system for projects involving the introduction of exotic species in protected areas and critical habitats, especially in areas where native species have similar ecological requirements as the exotic species.
- Implementing EIS for projects involving the introduction of species in areas where native species do not have natural predators (e.g., island endemics).
- Implementing the provision stating that the introduction of exotic species in private/public forests is considered an Environmentally Critical Project (ECP) (Sec AII, 3), and all proposed projects have to submit a full-blown EIS instead of a mere Initial Environmental Examination (IEE) checklist.
- Requiring an Environmental Guarantee Fund as an insurance payment for any damage, including the impact from IAS introduction, release, and dispersal, and to cover the restoration cost and compensation damages.

B. Objectives and Action Plan

The objectives identified to address Strategic Goal 2 include as the first objective the identification of new introductions of IAS and potential IAS. One action to be pursued is the development and maintenance of accessible national IAS database to be incorporated in the global IAS database. Other strategies are the development of official criteria of invasiveness, conduct of pest risk assessment, preparation of a comprehensive database of potential and existing IAS pathways, improvement of existing quarantine procedures in the ports of entry, provision of IAS identification capability trainings and enhancement of public education and outreach programs.

The second objective is the prevention of new introductions of IAS. There are also action plans that have been identified to be able to attain the objective at the set target time frame with the participation of lead and participating objectives as shown in Appendix 2.

Strategic Goal 3 – Early Detection and Rapid Response

A. Implementing Guidelines

- Early detection of new introduction of IAS and commitment to take rapid action is essential for successful and cost effective eradication of invasive species
- Early detection of IAS in biodiversity-significant and vulnerable ecosystems should be accorded the highest priority for action
- Rapid action to prevent the spread of IAS is necessary even if there is scientific uncertainty about the long-term outcomes of the potential invasion.

Not all efforts to prevent the introduction and spread of IAS are successful and guaranteed. Invasive species have the ability to establish rapidly in new areas, hence, requiring prompt decision and response. The challenge is to develop and implement effective and efficient ways to eradicate or contain an introduced species before it becomes widespread and not to wait until full-blown scientific and economic information are available.

Eradication of IAS should be done almost immediately upon discovery of new invasive populations because the chance of successfully controlling them as well as the associated costs increase as the invading populations spread (Veitch et al., 2011). Species known to be invasive elsewhere, especially those known to be invasive within a particular island/province/region or neighboring countries should be given priority. A review of the plant eradication programs in New Zealand showed the early removal of invasive plants costs 40 times less compared when removal was after the plants have widely established (Harris and Timmins, 2009). Furthermore, the impact of new and localized IAS populations would be much less and relatively more manageable when actions are taken immediately as soon as the IAS are detected.

According to Simberloff (2009), the successful eradications of IAS in many countries have key common features, namely (1) detecting an invasion early and acting quickly to eradicate the invasive species; (2) sufficient resources allocated to the project from start to finish including post-eradication surveys; (3) a person or agency with the authority to enforce cooperation; (4) the targeted species studied well enough to suggest vulnerabilities (often basic natural history suffices); and optimistic, persistent and resilient project leaders.

Developing an Early Detection and Rapid Response (EDRR) system can greatly improve the chance of preventing or impeding the establishment of IAS populations before they spread at a level which is difficult and much more expensive to contain and eradicate. EDRR system is comprised of three tiered actions, i.e., early detection followed by rapid reporting, and finally, timely response

to incipient invasion. The EDRR process should be able to detect new invasive species in time to prevent the permanent establishment and spread and to identify potential threats of IAS early enough to allow the implementation of appropriate control measures. A "hotline" communication system with supportive mechanisms for species identification, verification, and assessment should be developed. Eradication as a rapid response to early detection is cost-effective and generally successful. It may be necessary in certain cases, depending on the complexity and extent of IAS problems, to develop a distinct and separate EDRR system for each taxonomic group, ecosystem type and IAS pathway.

The EDRR system is a coordinated planning process involving field staff and the public. Local people with local knowledge can be engaged in early detection and reporting. The field administrative and operational staff of DENR and DA as well as the local government units can be trained to provide the technical and administrative support for the EDRR system. The involvement of a local network of biologists, trained farmers and volunteers in early detection of new infestations can also help ensure the successful implementation of an EDRR system. Developing an EDRR Manual, which sets the key principles, methods/procedures and IAS taxonomic record listed according to levels of risk and management priorities will support both prevention and early detection efforts.

The programs/activities which can incorporate the DENR process include Resource Basic Inventory (Memorandum Order No. 10/1991), preparation of NIPAS management plan (DAO No. 2008-26) and Biodiversity Monitoring System (NORCDECO/DENR, 2001). During the assessment and monitoring, sightings of new IAS should be recorded and reported immediately. A more focused ground survey can also be implemented to determine if high risk invasive alien species are present or not, and if present, to map their location and distribution.

B. Objectives and Action Plan

There were three objectives identified to be pursued for Strategic Goal 3. The first objective is to identify IAS present in the Philippines with five action plans to be carried out in various target timelines of short, medium and long term. The other two objectives are to develop tools to rapidly report new IAS introduction and to respond quickly and effectively to reports of invasive species. The lead and participating organizations to work on the implementation of all the plans in relation to Strategic Goal 3 are also shown in Appendix 3.

Strategic Goal 4 – Control and Management

A. Implementing Guidelines

- Containing the impact of IAS is more cost effective if done in the early stages of invasion when populations are small and localized.

- Best practice approaches are needed to reduce the adverse effects of control efforts on natural ecosystems, beneficial species and human health.
- Available options or technologies should be explored and assessed for effective control and management.
- Eradication should be ecologically feasible (e.g., no long-term effects on non-target native species), ethically humane and sustained with regular and consistent financial and political support.
- Some incidental loss to non-target species may be an inevitable consequence of eradication and should be balanced against the long-term benefits to biodiversity conservation.

A large number of IAS are already established and widespread in the Philippines and eradication of large IAS populations across large areas may not be logically possible or viable. The challenge is to be able to reduce the impacts of widespread IAS. To prevent invasive species from spreading to uninfected areas, containment methods should be applied. Priorities for the control of IAS must be determined, focusing on problem areas or species where the benefits of control are greatest, or where the benefits outweigh the cost.

Control and management strategies aim to evaluate, remove (eradicate) and contain IAS population. Efforts to control IAS are costly, tedious and labor intensive. The level of difficulty in eradicating IAS depends on the type, abundance, and geographic distribution of the targeted species as well as the physical and biological features of the invaded habitat, including its ecological complexity, coverage and sensitivity (Kolar et al., 2010). Unfortunately, some control efforts create disturbance on habitats that may become vulnerable to subsequent invasions. The occurrence of collateral damage to non-targeted species, including native species, has also been reported (Britton et al., 2008). The risk is particularly high in countries like the Philippines where many endemic species occur. Hence, best practice approaches are needed to reduce the adverse effects of the control efforts on beneficial species and the environment.

Before applying any of the control methods, a thorough screening process should be conducted. A site-specific strategic management plan should be formulated to include the development and implementation of control and containment procedures including the monitoring and evaluation of the effectiveness of the control activities to be undertaken. The decision as to which method or combination of methods to be used should be done on a case to case basis by taking into account the pros and cons of the different eradication approaches, adequate knowledge about the species to be eradicated, the characteristics of the habitat, the perceptions of the affected local communities and the basic information about the native and endemic fauna present in the area.

There are different control methods against IAS. There are manual (e.g., hand pulling), mechanical (e.g., trapping), chemical (e.g., using pesticides and herbicides) and biological (e.g., introducing predators, parasites, pathogens) approaches. Mechanical methods are usually used at the early stage of invasion when IAS are just starting to establish or when populations are small and have limited distribution. Chemical methods are often used when mechanical methods become impractical. However, improper use of chemicals can cause pollution and adversely affect the survival of some native species and so caution should be exercised. For example, organo-chlorine pesticides should not be used.

Biological control is used to control IAS by using natural enemies. For example, the common carp (*Cyprinus carpio*) was found in some countries to be an effective biological control agent against the invasive golden apple snail (*Pomacea canaliculata)* (Wong et al., 2009). Although there had been many successful cases of biocontrol, it is not a panacea because it can produce unintended consequences. Today, the common carp is an invasive species, feeding mainly on several aquatic invertebrates, plants and algae including the tree seeds and wild rice. It churns up the sediments on the bottom of the water ad in the process, uproots macrophytes that are essential habitats of native fish and other native aquatic species. In the Philippines, the molly fish (*Mollienesia latipinna*) was introduced initially to control mosquitoes, but it was found to prey not only on malaria-carrying mosquitoes but also on other native and economically beneficial insects (Juliano et al., 1989). Without proper and careful application and prior screening, biocontrol, as in other control methods, can cause more harm than good. The International Plant Protection Convention has issued the "Code of Conduct for the Import and Release of Exotic Biological Control Agents" to safeguard the import, export and release of exotic biological control agents.

Many of the control methods have limited potential for eradication and their uses will vary depending upon the species and location (Mueller, 2005). Control strategies, for instance in terrestrial ecosystem, must include eradication to eliminate all individuals and the seed bank from an area. In the eradication of vertebrate pests, Bomford and O'Brian (1995) suggest that managers must be able to detect and remove all individuals, outpace reproduction and commit adequate resources to ensure completion. The eradication of some vertebrate pests (e.g., feral cats and dogs) has also animal welfare and ethical implications that would necessitate compliance with relevant legislation (e.g., Philippine Animal Welfare Act or Republic Act No. 8485/1998). Invasive fish populations are usually controlled using nets, traps, spears, poison and/or modifying water level and flows. The success of these control methods varies. The application of the integrated pest and weed management has been proven to be beneficial in controlling some IAS in agricultural crops. Given that the eradication and control measures for marine IAS are more difficult and complex, inter-island and international cooperation is needed. The use of bounty payments (i.e., cash incentive awarded by the

government for eradicating certain quantities and types of IAS) may also be considered, although this can be very costly, and if not properly monitored, can be abused and attract fraudulent practices.

Targeting multiple species in an eradication program would require different sets of eradication methods, equipment, and trained personnel. Priority should be given to management techniques which will deliver the greatest benefits. Field training on how to properly use these techniques is essential.

The success of controlling IAS will depend on the proper and sustained implementation (hence committed funding) of the control and management plan. To ultimately reverse the rate of biodiversity loss, the control and management plan should consider the entire ecosystem and include assessments of the state of invaded ecosystem before drastic eradication efforts are implemented. Control strategies should also adapt to changing environmental and social conditions. Given that some effects of eradication on ecosystems are uncertain, the IAS management process should be iterative or adaptive, meaning that any management strategy predicted to produce the desired result should be monitored and evaluated for its outcome and should be subsequently modified, if necessary, in light of new and emerging information.

Enforcement of relevant legislation and policies will be needed to facilitate the control and eradication of invasive species. For example, DA-BPI has intermittently issued Special Quarantine Orders in response to the presence or eminent spread of animal pests in the Philippines. As stated under Strategic Goal 2 (Prevention), proactive management measures would have been more effective and cost effective than mere reactive response to IAS problems. Annex 5 lists examples of quarantine regulations issued to control the spread of crop pests in the Philippines.

B. Objectives and Action Plan

For Strategic Goal 4, there were three objectives identified to pursue through the short, medium and long term timelines of the NISSAP. Objective 1 is to assess areas with widespread infestation; Objective 2 is to reduce harmful impacts of IAS by containing the infestation and preventing further spread; and Objective 3 is to assess the effectiveness of the control and management strategies. The respective action plans were also identified for execution to achieve the said objectives as shown in Appendix 4.

Strategic Goal 5 – Restoration

A. Implementing Guidelines

- A mix of appropriate and locally adaptive native species should be planted in the restoration and rehabilitation of protected areas and critical habitats.

- A broad participatory and consultative strategy in restoration should be an integral part of planning and management to build community support.
- Translocation and re-introduction of native fauna as part of the restoration plan should be subjected to the Environmental Impact Assessment (EIA) process.
- Restoration (including eradication or control) costs due to unauthorized intentional introductions should be shouldered by the offenders.

Restoration, while costly and time consuming, is an essential phase after the invasive alien species have been eradicated or contained. It aims to rehabilitate IAS-damaged areas, minimize re-invasion and prevent another invader to replace the eradicated species. Restoration management has to integrate the protection of the remaining native species that may have survived the invasion and control procedures. The protection of these areas and the native species threat, when implemented alongside restoration efforts, will facilitate natural regeneration, re-colonization by native species, re-establishing an area back to its natural (if not original) state and ultimately, reversing the rate of biodiversity loss.

The success of restoration program depends, among others, on the history of invasion. For example, invasive alien plants that have established on a particular site for a long period of time might have already deposited a seed bank large enough to disrupt the input or emergence of native seeds, hence, making restoration very difficult and challenging. Thus, restoring areas before invasive species become extensively established is crucial to reduce the magnitude of biological invasion. Successful eradication and subsequent restoration of native species and ecosystems have been documented in Hawaii, New Zealand and Australia (Veitch et al., 2011). McGeoch et al. (2010) report that 11 bird, 5 mammal, and 1 amphibian species in the IUCN Red List have improved their conservation status as a result of the eradication of invasive species and restoration of their habitats.

There are some examples demonstrating the importance of ecological restoration in IAS management. The study of Bakker and Wilson (2004, p. 1058) showed that the restoration of an old field using native grass species "acts as a filter, containing invasive species while allowing colonization by native species". In the Philippines, studies have shown that regenerating secondary forest can support a wide variety of native mammals, many of which play a critical role in habitat regeneration as agents of seed dispersal and as natural buffers against invasion by alien pest species (Rickart, 2006 in Catibog-Sinha and Heaney, 2006). Planting native wild food plants in the rehabilitation of protected areas in the Philippines can attract seed-dispersing birds and mammals (Catibog-Sinha 1994; Ingle, 2003). These plants, when planted at forest fringes, can also serve as a physical barrier to the influx of

unwanted species into the forest interior. The use of a variety of native species, vines and understory trees at buffer zones around protected areas can provide a vegetation structure less permeable to invasion of wind-dispersed weeds (Cadenasso and Pickett, 2001). It was observed that intact forest edge serves as functional barrier to the flux of invasive species from the surrounding landscape into the forest interior.

Reforestation projects in the Philippines can incorporate the eradication and control of IAS by promoting the use of locally adapted and appropriate native species. The DENR policies on upland management program, community-based forestry, reforestation and agroforestry including the National Greening Program (NGP) can support IAS management by strongly promoting the use of native species. The "Guidelines on the Integration of Rainforestation Farming Strategy in the Development of Open and Denuded Areas within Protected Areas and other Appropriate Forest Lands" (DENR Memorandum Circular 2004-06) exemplifies such effort. Guidelines on the restoration of open and denuded areas within national parks and other protected areas to enhance biological diversity (DENR Memo Circular No. 20/1990) were also issued, emphasizing the use of native tree species, preferably those that bear fruits and flowers, which will also supplement the wild food diet of native animals. Furthermore, the restoration of areas damaged by IAS can benefit from the DENR Memo Circular (No. 2009-07), which sets some guidelines and procedures on the role of the Research Sector in the implementation of the Upland Development Program. The Order includes the production of quality planting materials, including native species for the restoration of protected areas and critical habitats.

A well-planned agroforestry project established within or adjacent to protected areas can be part of a restoration plan. However, cultivated plants including reforestation species introduced in agroforestry areas can become invasive and contaminate (i.e., through hybridization) the genetic integrity of native relatives in the adjacent natural forest. Species to be planted and propagated in agroforestry should, therefore, be limited to locally grown native plants of mixed species, preferably planted at different time intervals, to simulate a structurally diverse natural forest.

Although translocation of native fauna is possible in areas where IAS had been removed, caution should be exercised because the impacts of animal translocations are unknown and success may be difficult to predict in a short-term. The IUCN (1995) provides guidelines on the reintroduction of animal species, emphasizing the need for thorough assessments before introducing fauna back in the wild.

B. Objective and Action Plan

The NISSAP has forwarded only one objective to carry out in relation to Strategic Goal 5. This objective is to restore areas where IAS have been removed. Five action

plans will be done to address this goal. One of the strategies is the development and implementation of a restoration plan. Another is the use of appropriate and suitable native species in the restoration of areas where IAS have been removed. A third approach is to incorporate IAS-control and eradication requirements for all upland and community-based forest agreements and other similar contracts. The fourth and fifth schemes are to strengthen the implementation of existing restoration/rehabilitation policies and regulations consistent with protected area management and EIS process and selection of non-invasive agroforestry crops that may be cultivated near protected areas. These action plans will be done over the short, medium and long range target timelines of NISSAP in collaboration with the lead and participating organizations. Appendix 5 shows these in detail.

Strategic Goal 6 – Research and Information Management

A. Implementing Guidelines

- Research information and data exchange are essential in setting up IAS management priorities.
- Cooperation within/among countries is fundamental in efficient information exchange on IAS.
- IAS-database should be free and accessible to the public nationally and globally.
- Research agenda and priorities should be developed to support and implement IAS training and maintenance of an online database network.
- Research and monitoring are needed to identify and assess the risks associated with changing climate and environment, increasing human activities in trade and travel, and other emerging and new IAS pathways.
- Lessons learned from the practical experiences in the management of IAS can contribute to strengthening knowledge base.

Strategic Goal 6 implementing guidelines are divided between research and management information.

1. Research

Research is a major and essential component of all aspects of IAS management (i.e., prevention, early detection and rapid response, control and management and restoration). Given that the impacts of IAS are not usually manifested until after several years or even decades from initial introduction and to be consistent with the Precautionary Principle, it is prudent to be cautious even in the absence of complete scientific data.

Although there is limited in-depth and science-based information about the IAS in the Philippines, basic research about the biology and ecology of these

species remains crucial in reducing their environmental and economicimpacts in the country. The basic research in IAS management may include the documentation of the taxonomic and/or common/local names ; biology and ecology of the exotic species being introduced and the native species that are likely to be affected by invasion (e.g., niche competition or overlapping use of food and space; presence/absence of natural predators and the characteristics of the area such as clearings, proximity to the forest, roadsides, near water courses where the introduction of exotic species will occur). The ecological information needed to determine the threats of IAS at the landscape level may include land use types (e.g., forest fragments, urban, grassland/pasture, wetlands); distribution and abundance of IAS; changes in the structure of the vegetation or habitat; changes in the distribution and abundance of the native species; types of interactions between IAS and native species (e.g., predation parasitism, competition); and other decimating factors within the study area which could exacerbate the impacts of IAS.

Field research data should be properly recorded and kept as part of the IAS national database. Voucher specimens of IAS should be labeled, identified and preserved in museums for future reference. Basic data on the characteristics and trends of various IAS pathways will provide a better understanding on how to address the intentional and unintentional introductions of IAS, each presenting different policy and management challenges. It is necessary to combine fundamental studies of the natural history and taxonomy of new and potential studies of the natural history and taxonomy of new and potential invaders with modern methods, instrumentation and analysis (e.g., Bryers et al., 2002; Simberloff et al., 2005).

Despite the absence of complete research data about IAS in protected areas and forests, the implication of IAS impacts on these areas can be initially deduced from preliminary field observation/studies and routine site assessment. For example, observations indicating a correlation between the extent of colonization of an exotic species and the decline of native species will provide an early warning to signal for an immediate and pragmatic management decision. The study of Gormley et al. (2011) shows that the current and potential distributions of established invasive species using either "presence-only" and/or "presence–absence" data could suffice for the immediate control and/or containment of certain known IAS. Research on the different control techniques (i.e., biological, mechanical, chemical) for different types of IAS and modes of introduction, establishment, and dispersal is urgent and necessary. A landscape approach to IAS management has to be explored as well.

Research can contribute to the development of new technologies and integrated approaches to reduce the impact of IAS. For example, research on

different control methods especially for aquatic invasive species is needed given that the finfish aquaculture species in the Philippines are predominantly exotic (Silva et al., 2006), some of which have already been reported to be invasive due to intentional and unintentional introductions. The social or human dimension of IAS management should also be assessed, especially in the eradication of species that are perceived to be harmful by scientists but considered commercially and culturally important by certain members of the local community. Through research, management gaps and options to improve the effectiveness of any IAS management intervention can be ascertained.

Participatory research can also be implemented wherein the local communities are trained and involved in data collection and monitoring. This method is not only cost-effective but also beneficial in terms of providing supplementary income for the locals as well as opportunities for them to be involved in IAS management, particularly during the early detection stage.

With increasing human population and globalization, new invasive species and emerging invasive issues are posing formidable research challenge especially in the Philippines where trained taxonomists, for example, are few. Thus, there is a need for government research agencies to coordinate closely with other researchers/scientists from the academic and research institutions and continue to provide both formal and informal training in the field of biological invasion, ecological restoration, and data management. For a more extensive and comprehensive research on IAS, a National IAS Research Program should be developed, incorporating all major research elements about IAS issues and management. An integrated research approach will provide support to decision-making and policy implementation, including the development of ecologically-sound management strategies for many of the small and vulnerable islands of the country.

2. Management Information

Research data concerning IAS can be compiled and shared by creating online information networks. Access to information about IAS through a database management system is an effective tool in prevention, early detection, and management. IAS records, including those from other countries, will support risk assessment and impact evaluation of proposed projects involving potentially invasive species and IAS pathways.

Research on IAS species can inform the evaluation and ranking of IAS according to risks and in setting conservation priorities. The database on noxious species, for example weeds, can provide valuable information that are useful to resource managers in assessing which weeds are problematic as well as to other researchers who are interested in experimenting new control and management strategies on weeds.

Some criteria for listing invasive species include: (a) species that have a high or serious potential threat to the environment, (b) species that have limited distribution within the Philippines, (c) species that are amenable to successful eradication or containment procedures. Distribution data and mapping of IAS (e.g., from GIS maps, aerial photos) will further help resource managers identify priority areas. The list has to be updated as new data are obtained. Technical expertise, adequate funding, data accessibility, and collaboration have to be sustained for successful information management initiatives.

It is recognized that the most reliable indicator that a species may become invasive is that it is an invader somewhere else. The Philippine IAS online network can be integrated into and harmonized with existing global networks (e.g., Asia-Pacific Invasive Species Network, Global Invasive Species Database, Global Invasive Species Information Network) to optimize resources and other data-sharing opportunities. The list will be updated as new data are obtained. Technical expertise, funding, data accessibility, and collaboration have to be sustained for a successful information management initiative.

B. Objectives and Action Plan

There are two objectives that would steer the actions to be pursued to realize Strategic Goal 6. The first objective is to conduct scientific research on various aspects of IAS and the second is to set up and manage a national IAS Information network. Action plans such as collection of baseline information and various sources about IAS will be done as well as the conduct of basic and applied research on IAS management, biology, ecology, prevention, control methods, impact mitigation, local use and risk criteria. Conduct of cost–benefit analysis of economically important exotic species taking into consideration the potential risks of becoming new invasive species will also be done. The use of traditional knowledge of indigenous and local communities in the development and implementation of measures to address invasive alien species will be tapped.

The second objective is to set up and manage a national IAS Information network. This objective will be pursued through the establishment of a standardized and harmonized national database on IAS, pathways and other relevant IAS data for management, research, and information-sharing with local, national and international users/stakeholders. Furthermore, collaboration with national and international organizations for effective sharing of data and field experiences will be promoted. The other specific of the action plan is presented in Appendix 6.

Strategic Goal 7 – Education and Public Awareness

A. Implementing Guidelines

- Public awareness campaign can be a tool in engaging the public in preventing introductions of IAS and in controlling the spread of alien species.

- Better information and education about IAS issues are fundamental in preventing or reducing the risk of intentional and unintentional introductions.
- The quality and consistency of IAS awareness program among relevant government agencies and stakeholders is necessary in the prevention, early detection, control and management of IAS.
- All stakeholders should be involved from the early stages of planning and management to avoid or minimize management and social conflicts.

Education is a key component in all aspects of IAS management, but most particularly in preventing and reducing the risk of intentional and unintentional introductions. Communities who are aware and understand the issues and problems of IAS can provide support to government initiatives in addressing IAS problems and by extension, biodiversity conservation.

Because different people have different levels of understanding, personal views and behavioral attitudes about the impacts of IAS, communicating with them can be challenging. The majority of the public who accidentally introduce IAS are unaware that their behavior and lifestyle can be pathways to IAS. For example, many tourists, probably due to ignorance, complacency, or carelessness, carry with them potentially harmful exotic species that are hidden in their shoes and backpacks. Farmers and aquaculture operators, who find short-term economic benefits from the utilization of IAS, may be intentionally maintaining large populations of invasive species regardless of the potential environmental risk. These groups including importers of plants and animals, operators of nurseries and zoos, landscape developers, and others, who have direct contact with natural resources, have the potential to serve as pathways of IAS and should be prioritized in public education and awareness about IAS and their impacts on the environment, health and economy.

The Philippine government agencies, who have direct and indirect hand on IAS management such as DENR and DA, can integrate public education and general awareness about IAS in existing programs and projects. Government regulations and efforts to prevent IAS introduction should be part of the education, information and communication strategies. For example, prevention, early detection and reporting of IAS tend to be more successful when local communities are well informed as well as involved in the planning and management of IAS.

Establishing invasive alien species as a priority issue in biodiversity conservation has a leverage of public understanding and awareness if based on the results of consultative planning, informed decision and research. Well-communicated and easy to understand information based on research is also essential in promoting more meaningful education and public awareness.

B. Objectives and Action Plans

There were two objectives identified to fulfill this strategy. The first objective is to develop and implement a comprehensive education campaign program towards the promotion of public awareness on IAS as a biodiversity threat. A number of actions have been identified to satisfy this objective. One is to launch and conduct an IAS information campaign and public awareness program as part of the biodiversity program of the government. Another is to celebrate a yearly 'IAS Week' to promote public awareness. Provision of up-to-date information about IAS including relevant environmental laws, to a wide audience using different types of social media (e.g., Facebook, Twitter) will likewise be adopted.

The second objective is to monitor and assess progress of the comprehensive education and awareness program. Some of the strategies to make the objective happen include the formulation of a yearly monitoring scheme on the implementation of the comprehensive educational program and the identification of gaps in the said program. The specific target timelines and lead/participating organizations are further presented in Appendix 7.

Strategic Goal 8 – International Cooperation

A. Implementing Guidelines

- Collaborative bilateral, regional, and global actions to address IAS problems are more effective and efficient than isolated and unilateral actions by individual countries.
- An international regime to prevent IAS spread and introduction should be created for cohesive cooperation among neighboring countries.
- International cooperation relating to the management of IAS pathways (e.g., trade, tourism) that affect IAS introductions should be improved.

Governments, multilateral organizations and other relevant bodies are urged by the Convention of Biological Diversity (CBD) to cooperate and consider the potential effects of global change on risk of IAS to biodiversity (COP 6 Decision VI/23). The Philippines, as a Contracting Party to CBD and other relevant international treaties and agreements, has a commitment to reduce the rate of biodiversity loss by addressing IAS problems.

ASEAN countries, in particular, should work closely and collaboratively in ensuring that new introductions of IAS are prevented through trade and travel regulations. For example, IAS online database should be developed through collaborative sharing and contributions of research data and management at the global level. Provision of technical and financial support from overseas funding agencies is urgent and necessary to ensure the successful implementation of the NISSAP.

Annex 6 lists the relevant international conventions, agreements and treaties signed/ratified by the Philippines, which can provide numerous opportunities for international collaboration and assistance.

B. Objective and Action Plan

Appendix 8 shows that the objective identified for Strategic Goal 8 is to strengthen the Philippine role and capacity in meeting its commitment with international treaties and conventions including partnerships and networks within the Region. A list of actions has been forwarded to carry this out. One is to develop and/or enhance involvement in invasive species networks in the Region (e.g., Asia-Pacific Forest Invasive Species Network, Centre for Agriculture and Bioscience International, Association of Southeast Asian Nations Heritage Parks).Another is to implement the National Wetland Strategy and Action Plan (in compliance with Ramsar Convention on Wetlands). Furthermore, the incorporation of the IAS management as a major component of the Philippine Biodiversity and Action Plan (PBSAP) in line with the Aichi Biodiversity Target (Strategic Goal B, Target 9) will be done. Another planned activity is the provision of support to the capacity building activities of the national agencies in their respective obligations to international committees (e.g., CBD, CMS, Ramsar, CITES, Ballast Water Management (BWM) Convention, United Nations Framework Convention on Climate Change (UNFCCC), etc.). Furthermore, dialogues with regional and international tourism organizations on the prevention of IAS introduction through pathways in tourism, travel and recreational activities within protected areas will be carried out with concerned entities. The BWM Convention is also planned to be ratified.

Strategic Goal 9 – Training Needs and Capacity Building

A. Implementing Guidelines

A Training Needs Assessment (TNA) was conducted to identify training needs in order to develop an IAS Training Strategy. This formed the basis of the courses that were identified (existing or needed development) and capabilities (existing or needed identification) and implemented within the Project timeframe to build capacity on IAS management and prevention.

B. Objective and Action Plan

A National Learning Framework considers three major objectives as shown in Appendix 9. The objectives include the development of a national training standards and materials; the organization and maintenance of a training consortium that will implement the strategy among different sectors and geographic areas and the roll out of the strategy across the entire country.

Objective 1, which deals on the development of national standards, ensures guidelines for a range of training courses for different knowledge and skills, training

methods and content for different target groups, participation in demonstration projects and incorporation of repeat training at intervals.

Since information services, networking and skills sharing are considered vital, Objective 2 will address this by organizing and maintaining a mechanism for technical and guidance support with the participation of local or regional invasive species experts. Training services from qualified and competent training institutions shall also be established and maintained. The development and promotion of links to local, national and international institutions that provide training services will also be resorted to.

Objective 3 addresses the roll out strategy or entry into the existing systems. Some aspects to be considered are the roles of participating institutions, identification of skills gaps, prioritization of trainings to be conducted, planning and training delivery, and securing management and staff commitment. Appropriate training for involved sectors will also be pursued to involve volunteers in science or citizen science.

Citizen science is defined as volunteer collection of biodiversity and environmental information, which contributes to interpretation and expansion of knowledge of the natural environment. This includes biological monitoring and collection of environmental observations (Tweddle et al., 2012; Roy et al., 2012).

Appendices

Appendix 1: National Invasive Species Strategy and Action Plan (NISSAP) Strategic Goal 1: Leadership and Cooperation-Objectives and Planned Actions

Table A1: National Invasive Species Strategy and Action Plan (NISSAP) Strategic Goal 1: Leadership and Cooperation-Objectives and Planned Actions, 2020

Actions	Measurable Outcome	Assumptions	Cost (Php)	Target Timeline			Lead Organizations	Participating Organizations
				Short-Term (2020-2021)	Medium-Term (2022-2023)	Long-Term (2024-2030)		
Objective 1: To streamline/integrate IAS management concerns within existing committees already established within each bureau by virtue of Joint Administrative Order								
Strengthen and broaden the membership of existing (i.e., National Wildlife Management committee and the National Aquatic Wildlife Management Committee) • Integrate IAS concerns and issues in the agenda of the above- mentioned management committees	• A Joint Administrative Order on IAS to strengthen and expand the memberships of existing committees and their functions	Four (4) one-day mtgs. w/ 40 participants (inc. Secretariat) @ 1,500/pax/mtg. (venue and food)	240,000	■			DENR, DA	Other national government agencies, LGUs, Civil Society Organizations (CSOs), academia, other interested stakeholders
	• National IAS coordinating body established	Four (4) two-day mtgs. w/ 40 participants (inc. Secretariat) @ 2,500/pax/day (accomm. and food)	800,000	■			DENR, DA	DENR, DA
Objective 2: To create a national IAS coordinating body by virtue of an Executive Order								
Draft and facilitate the signing of an EO establishing the National IAS Coordinating Body	• EO signed and implemented				■		DENR, DA	Other national government agencies, LGUs, CSOs, academia
• Establish Regional units to implement at the regional level	• Regional units established to implement NISSAP	15 members including Secretariat/Region x 17 Regions x 4 one-day mtg./year @ 1,500/pax (This can be integrated as part of the monitoring function of the DENR field personnel)	714,000		■			
• Create a Technical Working Group to oversee the technical implementation and monitoring of NISSAP	• TWG created and mobilized	Three (3) two-day mtgs. w/ 25 participants (inc. Secretariat) @ 2,500/pax/day (accomm. and food)	375,000		■			
• Assign an independent Experts group, if necessary, to address technical issues that may require impartial and science-based opinion	• Independent experts assigned	NWMC may serve as the independent experts body			■			
• Create a Secretariat to provide administrative support to the committee and groups	• Secretariat created and mobilized				■			
TOTAL			**2,129,000**					

Appendix 2: National Invasive Species Strategy and Action Plan (NISSAP) Strategic Goal 2: Prevention-Objectives and Planned Actions

Table A2: National Invasive Species Strategy and Action Plan (NISSAP) Strategic Goal 2: Prevention-Objectives and Planned Actions, 2020

Actions	Measurable Outcome	Assumptions	Cost (Php)	Target Timeline			Lead Organizations	Participating Organizations
				Short-Term (2020-2021)	Medium-Term (2022-2023)	Long-Term (2024-2030)		
Objective 1: To identify new introductions of IAS and potential IAS								
Develop and maintain an accessible national IAS database (to include exotic species introduced in the country) which will be fed to the global IAS database	• International and national classification lists with complete information about each identified IAS and are accessible to all stakeholders	Development of IAS database: Php500,000 Hiring of systems developer: 2 Computer programmer II (one each for DENR and DA) @ 300,000/year x 11 years = Php6,600,000	7,100,000	■			DENR-BMB	DENR, DA, National Museum, universities
Develop official criteria on invasiveness	• Policy on official criteria on IAS issued	Done (c/o PPCC and PRLC)			■		DENR-BMB	BAI, BFAR, BPI, IPs, private sector
Conduct a Pest Risk Assessment based on the criteria (e.g., biological, ecological, cultural, geographical location and economic criteria and historical records of introduction)	• Priority list/ranking of IAS prepared, giving priority to IAS in global lists and those that are recognized by the ASEAN countries	Convene PRLC and PPCC meetings for this purpose PPCC = 3 mtgs. (2 days) for 1 year @ Php250,000/mtg. PRLC - = 3 mtgs. (2 days) for 1 year @ Php300,000/mtg.	1,650,000		■		DENR-BMB	BAI, BFAR, BPI, IPs, private sector
Prepare a comprehensive database of potential and existing IAS pathways in the Philippines (i.e., international and domestic routes) with proposed management strategies	• Database of IAS pathways in the Philippines and management strategies prepared	Costs to be subsumed under the development of database and hiring of personnel for this purpose		■			MBM, BPI, BFAR	ERDB, FMB, IPs, universities
Improve the existing quarantine procedures in the ports of entry to include the inspection of farm and industrial machineries which are potential pathways of IAS	• Facilities in the ports of entry upgraded	To be determined by other concerned agencies (c/o DA, BOC, etc.)		■			DA	DENR-BMB, BAI, BFAR, BPI
	• Surveillance policies upgraded	IAS Coordinating body and TWG mtgs., 4 mtg./year (meetings subsumed under Goal 1)						

Table A2: National Invasive Species Strategy and Action Plan (NISSAP) Strategic Goal 2: Prevention-Objectives and Planned Actions, 2020 (continued)

Actions	Measurable Outcome	Assumptions	Cost (Php)	Target Timeline			Lead Organizations	Participating Organizations
				Short-Term (2020-2021)	Medium-Term (2022-2023)	Long-Term (2024-2030)		
Provide IAS identification capability trainings	• Identification manuals to be developed	Manual on IAS flora, fauna, fish **Manual development cost**: 3 Consultants for 5 months @ 100,000/consultant = Php300,000 **Reproduction cost**: (1000 copies/manual @ 800/copy) = Php2,400,000	2,700,000	■			DENR	BPI, BFAR, BAI, IPs, DTI, private sector
	• Trainings for customs officers, wildlife enforcement officers, wildlife monitoring unit team, quarantine staff and relevant agencies conducted	Continuous roll-out (Luzon, Visayas, Mindanao cluster) Two (one each for DA and DENR) 1-week trainings / Regional cluster x 70 @ 2,500/pax/day (live-in) + transportation (6 x 300,000 = 1,800,000) (to be conducted every 3 years)	21,150,000					
		For DENR Field personnel and other gov't agencies Continuous roll-out (Luzon, Visayas, Mindanao cluster) Two (one each for DA and DENR) 1-week training/ Regional cluster x 70 @ 2,500/pax/day (live-in) + transportation (6 x 300,000 = 1,800,000) (to be conducted every 3 years)	21,150,000					
Enhance public education and outreach program • Disseminate IAS information at airports and seaports	• Information, education and communication campaigns (tri-media)	Development and placement of advertisements/ infographics for LED monitors at airports/seaports = Php2,000,000 Posters (10,000 posters / year each for terrestrial and aquatic flora and fauna spp. @ 100/pc for 5 years (reproduction every after year)= Php5,000,000	7,000,000	■			DENR	BPI, BFAR, BAI, IPs, DTI, NIA, private sector

Table A2: National Invasive Species Strategy and Action Plan (NISSAP) Strategic Goal 2: Prevention-Objectives and Planned Actions, 2020 (continued)

Actions	Measurable Outcome	Assumptions	Cost (Php)	Target Timeline			Lead Organizations	Participating Organizations
				Short-Term (2020-2021)	Medium-Term (2022-2023)	Long-Term (2024-2030)		
Objective 2: To prevent new introductions of IAS								
Enhance the enforcement of existing import/export permit regulations, biosafety/quarantine mechanisms and border inspection procedures • Revisit MOA of DA-DENR on the implementation of appropriate treatment of forest-based products	• Enhanced enforcement capabilities	Meetings - 4 quarterly (2 days) for the first year x 50 pax x 2,500/pax/day	1,000,000	■			DENR, DENR-BMB, DA, BAI, BFAR, BPI	All concerned government agencies, private sector
Consolidate and harmonize all sectoral legislative preventive instruments into a cohesive and comprehensive legal framework	• Codified sectoral legislative instruments	Harmonized and seamless legal framework			■		DENR, DA	All concerned government agencies
Develop grants and incentive programs for voluntary cooperation of pet shops, nurseries, botanic gardens, zoos, tree plantation/concessions, private individuals, etc. to report, register or surrender possession of IAS	• Grants and incentive systems developed	Develop the criteria and guidelines for providing grants/incentives: Three (3) two-day mtg.-workshop x 50 pax (inc. Secretariat)/workshop @ 2,500/pax/day = 750,000 Drafted DAO to serve as one of the outputs One (1) national consultation with the private sector to present the draft policy: 100 pax @ 2,000/pax = Php300,000	1,050,000	■			DENR, DA	Private sector
Regulate and monitor the cultivation, distribution, sale, resale, supply and propagation/breeding of IAS including those species being used for landscaping projects especially those near protected areas and critical habitats.	• Number of violators apprehended	Integral part of the regulatory function of mandated agencies (Costs involve allowances, per diems for mobilization of field implementors)			■		DENR, DA	DTI-BTRCP, private sector
Mainstream IAS into the existing EIS system to include prevention, control and regulation of IAS in protected areas, critical habitats and protected forests.	• Implementing rules and regulations of the EIS system updated and enhanced.	Four (4) two-day mtg.-workshop for one year @ 40 pax (inc. Secretariat) x 2,500/pax/day	800,000	■			DENR-EMB	DENR-BMB, BFAR, FMB, BPI

Table A2: National Invasive Species Strategy and Action Plan (NISSAP) Strategic Goal 2: Prevention-Objectives and Planned Actions, 2020 (continued)

Actions	Measurable Outcome	Assumptions	Cost (Php)	Target Timeline			Lead Organizations	Participating Organizations
				Short-Term (2020-2021)	Medium-Term (2022-2023)	Long-Term (2024-2030)		
Promote public education and outreach program on existing and new IAS with proposed measures on what the public can do to prevent IAS introduction	• Integrated and comprehensive information, education and communication campaigns at all levels conducted (tri-media)	Two (2) CEPA meeting-workshop with media arm of various agencies @ Php300,000/mtg.-workshop	600,000	■			DENR, DA	Media-concerned agencies
Develop/improve on IAS clearing house with published research studies and roster of experts on IAS	• IAS website developed	IAS website maintained by ERDB, linked to BCH		■			DENR-BMB	ERDB, BFAR, FMB, BPI
Encourage private groups and entities in identifying IAS pathways to develop code of practice or other forms of self-regulatory mechanism	• Codes of conduct initiated by industries and private entities	Three (3) TWG Workshop with key private reps to develop the code of conduct: 300,000/workshop x 3 = 900,000 Three (3) regional cluster (Luzon, Vis., Min) forum to promote the code of conduct (one year only): 400,000/workshop x 3 = Php1,200,000	2,100,000	■			DENR-BMB	DENR-BMB, BFAR, FMB, BPI, and other stakeholders and private industries
TOTAL			**66,300,000**					

Appendix 3: National Invasive Species Strategy and Action Plan (NISSAP) Strategic Goal 3: Early Detection and Response Objectives and Planned Actions

Table A3: National Invasive Species Strategy and Action Plan (NISSAP) Strategic Goal 3: Early Detection and Response-Objectives and Planned Actions, 2020

Actions	Measurable Outcome	Assumptions	Cost (Php)	Target Timeline			Lead Organizations	Participating Organizations
				Short-Term (2020-2021)	Medium-Term (2022-2023)	Long-Term (2024-2030)		
Objective 1: To identify IAS present in the country								
Develop a list of IAS that are in the early stage of establishment (this is a sub- list of the IAS national database).	• List of IAS	Bi-annual mtg.-workshop @ Php250,000 per activity x 10 years	5,000,000	■			DENR-BMB	DA, Department of the Interior and Local Government (DILG), NM, LGUs, POs, NGOs, SUCs.
Identify, verify and diagnose services by maintaining a taxonomic, biological and ecological database of high risk IAS that are already present in the country	• Support services on IAS identification, verification and diagnosis (field guides, species fact sheets, etc.)	**Field guide/species fact sheet (terrestrial and aquatic)** **Development cost** Php200,000 **Reproduction cost** 150/copy x 1,000 copies x 15 spp. x 3 (to be reproduced every after 3 years) = Php6,750,000	6,950,000	■			DENR, DA	NM, Academe, NGOs
Integrate early detection efforts (e.g., field survey, inspection) in existing monitoring and surveillance programs and quarantine services	• Integrated detection with Biodiversity Monitoring System and other site assessment programs	Ongoing activity (no additional costs to be incurred)		■			DENR, DA	NGOs, CSOs, Academe, IPs, PAMB, FARMC
Conduct regular training of relevant government personnel and other stakeholders on the early detection and rapid response process	• Training	Target participants are PA managers Three (3) regional cluster workshop (Luzon, Visayas, Mindanao) for PA managers 1-week training / Regional cluster x 70 @ 2,500/pax/day (live-in) + transportation and incidental (3 x 300,000 = Php900,000) x 3 (to be conducted every three years)	10,575,000	■			DENR, DA	Academe, IPs, POs, NGOs
Promote public education and outreach program	• IEC (multimedia)	Similar to previous but focused on certain IAS spp. (separate for DENR and DA)	2,000,000	■			DENR–RPAO, DA, DILG	NGOs, POs, Media, Philippine Information Agency (PIA), SUC, Academe (all levels)

Table A3: National Invasive Species Strategy and Action Plan (NISSAP) Strategic Goal 3: Early Detection and Response-Objectives and Planned Actions, 2020 (continued)

Actions	Measurable Outcome	Assumptions	Cost (Php)	Target Timeline			Lead Organizations	Participating Organizations
				Short-Term (2020-2021)	Medium-Term (2022-2023)	Long-Term (2024-2030)		
Objective 2: To respond quickly and effectively to invasive species reports								
Eradicate new infestations as soon as they are reported and verified	• New infestations eradicated	Bi-annual meeting of the IAS Eradication Team 2,500/day x 2 days (live-in) x 50 pax x 2/year x 9 years + airfare and incidental expenses (Php300,000 / year)	7,200,000		■		DA (Quarantine)	DENR, NGOs, IPs, Philippine National Police (PNP), PO, LGUs
Prioritize the eradication of species in the early stage of establishment	• Prioritization of species to be eradicated	Eradication costs depend on the sp. involved and the extent of invasion. Creation of IAS Eradication Team to execute the eradication strategy inc. post-eradication monitoring and evaluation Review of existing quarantine laws and regulations and the crafting of additional guidelines, as necessary Three (3) two-day mtgs.-workshop @ 50 pax x 3,000/pax + airfare and incidental expenses (500,000)	1,400,000	■			DA	NGOs, POs, academe (NSTP), LGUs
Identify methods that reduce the risks inherent in eradication efforts Understand basic information on the biology/ecology of IAS to ensure that the eradication methods chosen are appropriate	• Appropriate control/eradication methods identified and applied	Cost will be determined in the process of identifying the applicable method of eradication to the IAS involved whether mechanical or chemical. Conduct of two (2) three-day workshop for this purpose: Php350,000/workshop	700,000	■			DA	Academe, NGOs
		Eradication costs depend on the sp. involved and the extent of invasion.						
	• Training manuals/field guides/species fact sheets	Specific to the eradication strategy (addressed under Goal 2)						

Table A3: National Invasive Species Strategy and Action Plan (NISSAP) Strategic Goal 3: Early Detection and Response-Objectives and Planned Actions, 2020 (continued)

Actions	Measurable Outcome	Assumptions	Cost (Php)	Target Timeline			Lead Organizations	Participating Organizations
				Short-Term (2020-2021)	Medium-Term (2022-2023)	Long-Term (2024-2030)		
Commit adequate resources to ensure completion of IAS eradication	• Adequate budget allocated			■			DENR, DA	DBM, LGUs, all concerned government units
Promote public education and outreach program	• IEC (multimedia)	Subsumed under the eradication strategy for the specific IAS		■			DENR-RPAO	Academe, NGOs
TOTAL			33,825,000					

Appendix 4: National Invasive Species Strategy and Action Plan (NISSAP) Strategic Goal 4: Control and Management-Objectives and Planned Actions

Table A4: National Invasive Species Strategy and Action Plan (NISSAP) Strategic Goal 4: Control and Management-Objectives and Planned Actions, 2020

Actions	Measurable Outcome	Assumptions	Cost (Php)	Target Timeline			Lead Organizations	Participating Organizations
				Short-Term (2020-2021)	Medium-Term (2022-2023)	Long-Term (2024-2030)		
Objective 1: To assess areas with widespread infestation								
Train personnel in the assessment of IAS impact	• Trained personnel	Per Region affected by a particular IAS Training on IAS impact for field implementors (regional clusters) (1 M per cluster each for DENR and DA)	6,000,000	■			DENR, DA	National Fisheries Research and Development Institute (NFRDI), DILG, Fisher folk organizations, Wildlife Enforcement Officers(WEOs)
Establish a collaborative Task Force/IAS units to carry out IAS control and management, including emergency funds in case of pest outbreaks	• Task force or IAS units established • Emergency funds established	Orientation workshop and subsequent mtgs. (addressed under Goal 3 - Creation of IAS Eradication Team) Annual emergency funds: 10 M (5M-DENR, 5M DA) x 9 years	90,000,000		■		DENR, DA	Enforcement agencies (PNP, Army and etc.), WEOs, DILG, Private entities
Set up a national and/or regional identification, verification and diagnostic services	• Technical support services on IAS established	NWMC and RWMC to serve as the technical support service for IAS concerns			■		DENR, DA	Academe
Identify the invasive species and affected areas that have the greatest impacts on the environment, biodiversity, human health and livelihoods.	• High risk IAS and affected areas identified	Review of regional reports and existing literature on IAS distribution (existing task of DENR Regional Offices) Field validation activities to identify highly affected areas and priority areas for control Survey per PA or managed ecosystem: Php100,000 / field survey x 150 x 3 (conduct every 3 years) (for DENR and DA)	45,000,000		■		DENR, DA	DOST, NM, Academe, NFRDI, DOH and hobbyists

Table A4: National Invasive Species Strategy and Action Plan (NISSAP) Strategic Goal 4: Control and Management-Objectives and Planned Actions, 2020 (continued)

Actions	Measurable Outcome	Assumptions	Cost (Php)	Target Timeline			Lead Organizations	Participating Organizations
				Short-Term (2020-2021)	Medium-Term (2022-2023)	Long-Term (2024-2030)		
Survey area for the presence of native, endemic and threatened species that might suffer collateral damage from control methods	• Field survey of native species in areas to be de-infested	Separate field validation activities to identify highly affected areas and priority areas for control Php100,000 / field survey Survey per PA or managed ecosystem: Php100,000 / field survey x 150 x 3 (conduct every 3 years) (for DENR and DA)	45,000,000		■		DENR, DA	DOST, NM, Academe, NFRDI, DOH and hobbyists
Promote public education and awareness	• IEC (multimedia)	Conduct of information campaigns/fora for LGUs, DOT, DepEd (for teachers), CHED, PIA and media personnel Four (4) fora @ 100 pax @ 250,000/forum = Php1,000,000 Development and placement of advertisements, brochures and other information materials = Php1,500,000 Integration of IAS concepts in the Dalaw Turo and other CEPA initiatives of the DENR Two (2) one-day mtg. @ 600 x 50 pax = Php60,000	2,560,000	■			DENR, DA	PIA, Department of Education (DepEd), Media, DILG, Department of Tourism (DOT)
Objective 2: To reduce harmful impacts of IAS by containing the infestation and preventing further spread								
Prioritize control efforts based on impacts and outcome	• Prioritized efforts to reduce impacts	Mtg.-workshop to assess the control efforts identified Three (3) mtg. workshop @ 50 pax @ Php200,000 / workshop	600,000		■		DENR, DA	LGUs, CSOs, academe, National Commission on Indigenous Peoples (NCIP)
Assess cost-benefits (Total Economic Value) in the selection of control methods including their potential harm on non-target species	• Cost-benefit analysis of control methods	Consultancy work (Three experts @ Php250,000/expert)	750,000		■		DENR, DA	CSOs, NGOs, academe and other concerned government units

Table A4: National Invasive Species Strategy and Action Plan (NISSAP) Strategic Goal 4: Control and Management-Objectives and Planned Actions, 2020 (continued)

Actions	Measurable Outcome	Assumptions	Cost (Php)	Target Timeline			Lead Organizations	Participating Organizations
				Short-Term (2020-2021)	Medium-Term (2022-2023)	Long-Term (2024-2030)		
Develop and implement an IAS Operational Plan for high priority species, to include EIA, control and management regulations to contain infestation and best practice	• IAS Operational Plan developed and implemented	Cost would depend on the IAS species involved and the intensity of infestation. The cost is best determined in the IAS management planning process. Consultancy work: 2,500,000 Presentation of work output to involved agencies • 1 National Workshop: 700,000 • 3 Regional cluster workshop: 3 X Php500,000 *(Separate cost to be incurred for implementation)*	4,700,000		■		DENR, DA	DILG, DOH, NM, other stakeholders (hobbyists)
Develop integrated pest management projects for major IAS pathways (i.e., aquaculture, forestry, agroforestry, ornamental and pet industries)	• IPM projects developed	Shall form part of the IAS Operational Plan			■		DENR, DA	IPs, POs, local communities and other stakeholders
Conduct public consultation in deciding which control methods (including biocontrol) are appropriate and acceptable	• Public consultations held	300,000/Region x 17 Regions x 2 (DENR & DA) x 3 (to be conducted every 3 years)	30,600,000		■		DENR, DA	Research, IPs, POs, local communities and other stake holders
Reduce populations of invasive species as part of the routine maintenance of a particular area	• IAS population reduced	Shall form part of the routine function of the DENR and DA				■	DENR, DA	CSOs, academe, DOST
Promote the utilization of IAS for control and containment, subject to government regulations and provision of alternative livelihoods and to be supported by IEC	• Regulated utilization of IAS control measure	Shall form part of the routine function of DENR and DA			■		DENR, DA, DILG	DOST, academe, media, other assisting organizations
Engage volunteers in the manual/mechanical control of IAS	• Engaged volunteers	Community mobilization activities 300,000/Region x 17 Regions x 2 (DENR & DA) x 10 years	102,000,000		■		DENR, DA	All concerned government units and stakeholders, schools, local communities, universities, CSOs
Enhance public awareness	• IEC (multimedia)	Conduct of another round of information campaigns/fora for LGUs, DOT, DepEd (for teachers), CHED, PIA and media personnel Four (4) fora @ 100 pax @ Php250,000/forum = Php1,000,000	2,500,000	■			DENR, DA	DFA, DILG, DOT, PIA, DepEd, CSOs

Table A4: National Invasive Species Strategy and Action Plan (NISSAP) Strategic Goal 4: Control and Management-Objectives and Planned Actions, 2020 (continued)

Actions	Measurable Outcome	Assumptions	Cost (Php)	Target Timeline			Lead Organizations	Participating Organizations
				Short-Term (2020-2021)	Medium-Term (2022-2023)	Long-Term (2024-2030)		
		Development and placement of another round of advertisements, brochures and other information materials = Php1,500,000						
Objective 3: To assess the effectiveness of the control and management strategies								
Develop a list of management effectiveness indicators as part of a regular monitoring system	• List of management effectiveness indicators	Consultancy work (1 consultant each for DENR and DA for 1 month @ Php300,000/consultant)	600,000		■		DENR, DA	Academe, external/internal evaluators
Incorporate IAS management and monitoring program in all protected area management plans	• PA Management Plans integrating IAS developed	For DENR Park Superintendents Continuous roll-out (Luzon, Visayas, Mindanao cluster) One (1) three-day workshop/Regional cluster x 70 @ 2,500/pax/day (live-in) + transportation (3 x 300,000 = Php900,000)	2,475,000	■			DENR-BMB, DA	DILG, DENR
Implement regular post-eradication surveillance program to detect any re-infestation	• Post-surveillance program developed	Shall form part of the annual target of DENR and DA Regional offices			■		DENR, DA	DILG, CSOs, Volunteers
Train personnel, civil society organizations, local communities and volunteers to regularly assess and monitor the success of the eradication efforts	• Number of personnel and volunteers trained	Conduct of training per Region 17 Regions x 400,000 / Region x 2 (DENR and DA)	13,600,000		■		DENR, DA	Academe, NM, NGOs
TOTAL			**346,385,000**					

Appendix 5: National Invasive Species Strategy and Action Plan (NISSAP) Strategic Goal 5: Restoration-Objectives and Planned Actions

Table A5: National Invasive Species Strategy and Action Plan (NISSAP) Strategic Goal 5: Restoration-Objective and Planned Actions, 2020

Actions	Measurable Outcome	Assumptions	Cost (Php)	Target Timeline			Lead Organizations	Participating Organizations
				Short-Term (2020-2021)	Medium-Term (2022-2023)	Long-Term (2024-2030)		
Objective 1: To restore areas where IAS have been removed								
Develop and implement a restoration plan by taking into account the following steps: • Baseline gathering (inventory of flora and fauna and their present uses) • Zoning of subject area • Habitat restoration • Participatory monitoring and evaluation	• Restoration plan developed and implemented	• PAs have baseline data • To be addressed under Goal 4, Objective 3 (Integration of IAS concerns in PA management plans) • Actual costs will depend on the area to be restored and the restoration approach to be employed per species • Short-term: 70 M; medium-term: 70 M; long-term: Php250M	390,000,000	■	■	■	DENR, DA	CSOs,/NGOs, academe, private sector, LGUs and concerned stakeholders
Use appropriate and suitable native species in the restoration of areas where IAS have been removed	• Appropriate and suitable native species used in restoration	• Php12,000/ha planting • Monitoring cost • Determine area of degraded habitats in all PAs nationwide • Suitable native spp. to be determined during the development of the restoration plan			■		DENR	CSOs, NGOs, academe, LGUs
Incorporate IAS-control and eradication requirements for all upland and community-based forest agreements and other similar agreements	• Upland and forest agreements with IAS control provisions	• Three (3) workshop with FMB to review existing forest agreements and develop a policy on IAS • 3 Workshops x 50 pax x 3 days @ 2,500/day (live-in)	1,125,000		■		DENR, DA	POs, LGUs and concerned stakeholders
Strengthen the implementation of existing restoration/rehabilitation policies and regulations consistent with protected area management and EIS process	• Restoration/rehabilitation policies and regulations and EIS process strengthened	• Workshop/Consultation • One million - medium term; 2 million - long term	3,000,000		■	■	DENR, DA, PAMB	CSOs, NGOs, academe, LGUs and concerned stakeholders
Selection of non-invasive agroforestry crops that may be cultivated near protected areas	• Non-invasive agroforestry crops selected	Will be part of the agenda of the meeting workshop with FMB			■		DENR, DA	LGUs, NGOs, IPs, PAMB
TOTAL			**394,125,000**					

Appendix 6: National Invasive Species Strategy and Action Plan (NISSAP) Strategic Goal 6: Research and Information Management-Objectives and Planned Actions

Table A6: National Invasive Species Strategy and Action Plan (NISSAP) Strategic Goal 6: Research and Information Management-Objectives and Planned Actions, 2020

Actions	Measurable Outcome	Assumptions	Cost (Php)	Target Timeline			Lead Organizations	Participating Organizations
				Short-Term (2020-2021)	Medium-Term (2022-2023)	Long-Term (2024-2030)		
Objective 1: To conduct scientific research on various aspects of IAS management								
Collect baseline information and materials from various sources about IAS (e.g., IAS inventory, geographic distribution within country, region, islands; species biology and ecology; land use) and their potential impacts (e.g., biodiversity, economic, health, social) • Prioritize those IAS with existing scientific literature	• GIS-based maps • Literature reviewed • Invasion biology studies			■			DENR, DA	DOST, academe, NGOs/CSOs
Conduct basic and applied research on IAS management (e.g., biology, ecology, prevention, control methods, impact mitigation, local use, risk criteria	• Projects on priority IAS species	• IAS fauna: 20 species • IAS flora: 30 species • 10 IAS for short and medium term and the rest for the long term: Php1 M per species	50,000,000	■	■	■	DENR-ERDB, DA	DOST, academe, NGOs/CSOs
Identify and assess research gaps and priorities for high risk IAS and pathways	• Identified research gaps and prioritized high risk IAS and pathways through workshops, symposia, etc. • Research areas conducted/ completed	Consultancy work	500,000	■			DENR-ERDB, DA	DOST, academe, NGOs/CSOs
Conduct cost–benefit analysis of economically important exotic species taking into consideration the potential risks of becoming new invasive species (e.g., economic values and benefits, threats to health and environment)	• Economic valuation per species using available software	Consultancy work	500,000	■	■		DENR, DA	DOST, academe, NGOs/CSOs
	• Training modules developed, trainings conducted	Consultancy work: Php500,000	4,500,000	■	■	■	DENR, DA	DOST, academe, NGOs/CSOs
	- Number of personnel trained	Two (2) four-day national trainings @ 50 pax x 2,500/pax (live-in) + transportation (2 x 300,000 = 600,000)= Php1,600,000						
	- Number of IP leaders trained	Three (3) four-day regional cluster trainings with NCIP @ 50 pax x 2,500/pax (live-in) + transportation = Php2,400,000						

Table A6: National Invasive Species Strategy and Action Plan (NISSAP) Strategic Goal 6: Research and Information Management-Objectives and Planned Actions, 2020 (continued)

Actions	Measurable Outcome	Assumptions	Cost (Php)	Target Timeline			Lead Organizations	Participating Organizations
				Short-Term (2020-2021)	Medium-Term (2022-2023)	Long-Term (2024-2030)		
Develop an Integrated National Research and Development Programs on IAS, focusing on high risk pathways (e.g., aquaculture, forestry, trade, tourism) • Incorporate LGU-based research programs	• Research and development (R&D) programs developed at the national and local levels with adequate budgetary support	Assignment of ERDB (3 workshops) Three (3) workshops @ Php500,000/workshop	1,500,000	■			DENR-ERDB	DOST, academe, NGOs/CSOs
Use traditional knowledge of indigenous and local communities in the development and implementation of measures to address invasive alien species	• Traditional knowledge incorporated in the research and development agenda • Number of publication and conferences			■			DENR, DA	NICP, IPs, NGOs/CSOs, POs, academe
Objective 2: To set up and manage a national IAS information network								
Establish a standardized and harmonized national database on IAS, pathways and other relevant IAS data for management, research, and information-sharing with local, national and international users/stakeholders	• Database on IAS and their pathways (continuously updated, publications and symposia or conferences)	Two job contract staff (one each for DENR and DA) in support of the computer programmer hired under Goal 2 @ Php300,000/year x 11 years	6,600,000	■			DENR-BMB	All research agencies with IAS data
Coordinate the information network with those in the region (ASEAN) and globally	• Database available online, conferences and fora			■			DENR-BMB	All research agencies with IAS data
Provide technical/scientific support for and training on data management	• Training modules developed, trainings conducted and number of personnel trained	• Commissioned work for module development: 500,000 x 2 (one each for DA & DENR) = Php1,000,000 • Two (2) national trainings @ 500,000/training = Php1,000,000	2,000,000	■			DENR-BMB	All research agencies with IAS data
Commit financial, infrastructure and human resources to sustain and enrich the online network (from local, regional, national levels)	• Sufficient and adequate funds			■			DENR-BMB	All research agencies with IAS data
	• Lead agencies identified							
	• Online network established and operational	• 2 (one each for DENR & DA) job contract staff for 10 years • Addressed under Goal 2						
	• Local ordinances on IAS implemented	Mandated function of LGUs						

Table A6: National Invasive Species Strategy and Action Plan (NISSAP) Strategic Goal 6: Research and Information Management-Objectives and Planned Actions, 2020 (continued)

Actions	Measurable Outcome	Assumptions	Cost (Php)	Target Timeline			Lead Organizations	Participating Organizations
				Short-Term (2020-2021)	Medium-Term (2022-2023)	Long-Term (2024-2030)		
Promote collaboration with national and international organizations for effective sharing of data and field experiences (e.g., Citizen Science, Technical Working groups, Experts Directory)	• Networks established - A National IAS Research and Information Network, which will be responsible to source financial support, consolidation of results of research and other data gathered sharing of information is established; this may also serve as a venue for training and capacity building	Two (2) job contract staff for 1 year (one each for DENR & DA) @ Php350,000/staff	700,000	■	■		DENR-BMB	All research agencies with IAS data
TOTAL			**66,300,000**					

Appendix 7: National Invasive Species Strategy and Action Plan (NISSAP) Strategic Goal 7: Education and Public Awareness Objectives and Planned Actions

Table A7: National Invasive Species Strategy and Action Plan (NISSAP) Strategic Goal 7: Education and Public Awareness-Objectives and Planned Actions, 2020

Actions	Measurable Outcome	Assumptions	Cost (Php)	Target Timeline			Lead Organizations	Participating Organizations
				Short-Term (2020-2021)	Medium-Term (2022-2023)	Long-Term (2024-2030)		
Objective 1: To develop and implement a comprehensive education campaign program towards the promotion of public awareness on IAS as a biodiversity threat								
Launch and conduct an IAS information campaign and public awareness program as part of the biodiversity program of the government • Prioritization • Identify key problematic invasive species • Stratify the audience and then make a campaign • Local campaigns • Posters • Brochures • School tour • Social media • LGUs, mayors • Fishermen, farmers, etc. • Trainings, brochures	• IAS information campaign and public awareness program launched	• Two (2) consultancy work to develop the information strategy plan and materials: Php1 M • Production of info material: 5 M • Information caravan by region: 500,000/Region x 17 Regions x 2 rounds = Php17M	23,000,000	■			DENR, DA	PIA, Commission on Higher Education (CHED), DepEd, LGUs, media, outdoor/recreation organizations (e.g., birdwatchers, mountaineers/divers)
Celebrate a yearly 'IAS Week' to promote public awareness	• IAS Week celebrated	• Identify a program to be implemented every year (e.g. similar clean-up drives): 200,000/PA or managed ecosystems • 120 ecosystems x 200,000 x 10	240,000,000	■			DENR, DA	Schools, universities, LGU leagues
Provide up-to-date information about IAS including relevant environmental laws, to a wide audience using different types of media (e.g., Facebook and Twitter to contain trivia, peoples' reports of sightings of IAS, relevant laws and regulations, BMB announcements about IAS) • Verification of data by technical panel is required prior to press release	• Accurate and up-date-information provided	To be addressed in the website development		■			DENR, DA	All relevant stakeholders and the general public
Communicate with individuals and industries about IAS issues and resolve conflicts whenever necessary	• Communication and conflicts resolved	Php500,000/Region x 17 Regions x 2 years x 2 (one each for DA & DENR)	34,000,000	■			DENR, DA	DENR-BMB, BPI, BFAR, Laguna Lake Development Authority (LLDA), academe

Table A7: National Invasive Species Strategy and Action Plan (NISSAP) Strategic Goal 7: Education and Public Awareness-Objectives and Planned Actions, 2020 (continued)

Actions	Measurable Outcome	Assumptions	Cost (Php)	Target Timeline			Lead Organizations	Participating Organizations
				Short-Term (2020-2021)	Medium Term (2022-2023)	Long-Term (2024-2030)		
• Talk to pet breeders/fish breeders/pet shop owners • Educate organizations that conduct competitions and plant/animal shows (hobbyists, breeders, collectors) about relevant laws • Work with people in the academe • Education and awareness of quarantine officers, crucial gatekeepers, airports, seaports and bus terminals								
Ensure free public access to IAS database (data collected from other sources such as research institutions and the academe)	• Public access to IAS information provided			■			DENR-BMB, DOST	LLDA, DOST research councils, ERDB, NM
Encourage the public to be involved by organizing the activities by interest groups (volunteers, tourists, school children) in various aspects of IAS management	• Activities (e.g., Citizens Science Movement) organized by interest groups encouraged			■			DENR-BMB, DOST	LLDA, DOST, IPs, Research councils, ERDB, NM
Integrate IAS education and outreach program and other related activities	• Programs integrated	Commissioned work on module development for use of academic institutions	700,000	■			DENR-BMB, DOST	
Integrate IAS information and issues into the relevant courses and curricula in the formal educational system from the basic education (K-12 curriculum and in the tertiary level) in compliance with the provisions of the Republic Act 9512 (Environmental Education and Awareness Act of 2010) as implemented by its instituted Inter-agency Committee	• Topics related to IAS in the syllabi included	Three (3) convergence meetings-workshop w/ DepEd and CHED @ Php500,000/mtg.	1,500,000		■		DENR, DA, CHED, DepEd	Schools and universities
Objective 2: To monitor and assess progress of the comprehensive education and awareness program								
Formulate a yearly monitoring scheme on the implementation of the comprehensive educational program	• Come up with a tool to monitor and evaluate the implementation of the set activities	Consultancy work	700,000	■	■	■	DENR, DA	DepEd, CHED and public and private schools
Identify gaps in the comprehensive education awareness program	• Address identified gaps and make changes, if necessary	Four (4) meetings-workshop w/ DepEd and CHED @ 300,000/mtg. (one for short term; one for medium term; two for long term)	1,200,000	■	■	■	DENR, DA	DepEd, CHED and public and private schools
TOTAL			**301,100,000**					

Appendix 8: National Invasive Species Strategy and Action Plan (NISSAP) Strategic Goal 8: International Cooperation-Objectives and Planned Action

Table A8: National Invasive Species Strategy and Action Plan (NISSAP) Strategic Goal 8: International Cooperation-Objective and Planned Actions, 2020

Actions	Measurable Outcome	Assumptions	Cost	Target Timeline			Lead Organizations	Participating Organizations
				Short-Term (2020-2021)	Medium-Term (2022-2023)	Long-Term (2024-2030)		
Objective 1: To strengthen the Philippine role and capacity to meet its commitment with international treaties and conventions including partnerships and networks within the region								
Develop and/or enhance involvement in invasive species networks in the Region (e.g., Asia-Pacific Forest Invasive Species Network, CABI, ASEAN Heritage Parks)	• Enhanced partnerships in the region • Network mechanisms in place	Organize one ASEAN regional workshop on IAS	15,000,000	■			DENR-BMB, FMB	ACB, Fishbase Information & Research Group Inc. (FIN)
Implement the National Wetland Strategy and Action Plan (in compliance with Ramsar Convention)	• EO to implement NWSAP	Separate costing for the NWSAP		■			DENR-BMB	NEDA, Members of the National Wetland Committee
Incorporate IAS management as a major component of the Philippine Biodiversity and action Plan (PBSAP) in line with the Aichi Biodiversity Target (Strategic Goal B, Target 9)	• IAS as a component of PBSAP	Accomplished		■			DENR-BMB	All relevant stakeholders
Provide support to the capacity building activities of the national agencies in their respective obligations to international committees (e.g., CBD, CMS, Ramsar, CITES, BWC, UNFCCC, etc.)	• Capacity-building program on IAS for NGAs funded and implemented	3M (1.5 M each for DA & DENR)/year x 5 years	15,000,000	■			DENR-BMB/ concerned lead/focal agencies on international conventions	All relevant stakeholders
	• Participated in international fora/conferences/symposia on IAS	Allocation for attendance to international fora: Php4 M/year (for DA and DENR) x 10 years	40,000,000		■			
Initiate dialogue with regional (e.g., ASEAN) and international tourism organizations (i.e., UN World tourism Organizations) on the prevention of IAS introduction through pathways in tourism, travel and recreational activities within protected areas • Incorporate concerns on IAS in the Draft Philippine Ecotourism Strategy and Action Plan • Update/develop guidelines on ecotourism to include IAS concerns	• Partnerships forged • List of regional and international organizations established • Increased tourist number and tourist experience, inclusive growth, conservation of biodiversity	Two (2) national experts' workshop @ Php800,000/workshop	1,600,000	■			DOT, DENR-BMB	ACB, LGUs, POs, CSOs, NCIP, private sector

Table A8: National Invasive Species Strategy and Action Plan (NISSAP) Strategic Goal 8: International Cooperation-Objective and Planned Actions, 2020 (continued)

Actions	Measurable Outcome	Assumptions	Cost (Php)	Target Timeline			Lead Organizations	Participating Organizations
				Short-Term (2020-2021)	Medium-Term (2022-2023)	Long-Term (2024-2030)		
• Identify regional and international agencies with concerns on IAS								
Ratification of the Ballast Water Convention	• Ratification instrument	Accomplished			■		DFA, DOTC	DENR, IMO, Marine National Authority, Coast guards
TOTAL			**71,600,000**					

Appendix 9: National Invasive Species Strategy and Action Plan (NISSAP) Strategic Goal 9: Training Needs and Capacity Building Objectives and Planned Actions

Table A9: National Invasive Species Strategy and Action Plan (NISSAP) Strategic Goal 9: Training Needs and Capacity Building – Objectives and Planned Actions, 2020

Actions	Measurable Outcome	Assumptions	Cost (Php)	Target Timeline			Lead Organizations	Participating Organizations
				Short-Term (2020-2021)	Medium-Term (2022-2023)	Long-Term (2024-2030)		
Objective 1: To develop national standards and materials								
Ensure guidelines for a range of training courses for different required knowledge and skills	• Course designs developed - Description - Modules/materials - Identified trainee positions • Methodology options with identified experts • Monitoring requirements (reporting, knowledge/skills adherence, accessing knowledge management)	Consultancy work	1,000,000	■	■		DENR-BMB	DENR, DA, LGUs, NGOs, POs
Develop training methods and content for different target groups including formal courses	• Number of formal courses and training methods developed	Consultancy work	1,000,000	■	■		DENR-BMB	DENR, DA, LGUs, NGOs, POs
Participate in demonstration projects	• Number of demonstration projects participated in number of repeat trainings	Three (3) demo training/period at 500,000 per demo	4,500,000	■	■	■	DENR-BMB	DENR, DA, LGUs, NGOs, POs
Objective 2: To organize and maintain a training consortium								
Clarify and identify institutional responsibilities and roles	• Number of regional and technical advisers maintained	Roster of experts developed		■	■		DENR-BMB	International organizations, DENR, DA, LGUs NGOs, IPs, POs
Develop training methods and content for different target groups including formal courses	• Number of links to local, national, regional and international training institutions developed and promoted	Consultancy work	1,000,000	■	■	■	DENR-BMB	International organizations, DENR, DA, LGUs, NGOs, POs, IPs
Objective 3. To roll out the training strategy								
Develop and/or enhance involvement in invasive species networks in the Region (e.g., Asia-Pacific Forest Invasive Species Network, CABI, ASEAN Heritage Parks)	• Number of institutions/organizations identified	Link to the web to be developed		■			DENR-BMB	DENR, DA, LGUs, NGOs, POs, IPS
Identification of skill gaps	• Number of skills present and gaps needed to be addressed	National IAS Coordinating Body and its TWG to assess country capability and identify gaps		■			DENR-BMB	DENR, DA, LGUs, NGOs, POs, IPs

Table A9: National Invasive Species Strategy and Action Plan (NISSAP) Strategic Goal 9: Training Needs and Capacity Building – Objectives and Planned Actions, 2020 (continued)

Actions	Measurable Outcome	Assumptions	Cost (Php)	Target Timeline			Lead Organizations	Participating Organizations
				Short-Term (2020-2021)	Medium-Term (2022-2023)	Long-Term (2024-2030)		
Prioritization of training courses	• Number of training courses prioritized for implementation	• Trainings on IAS species management techniques 3 cluster trainings @ 1M per cluster/period x 2 periods x 2 (one each for DENR & DA)	12,000,000	■	■	■	DENR-BMB	DENR, DA, LGUs, NGOs, POs
Planning and training delivery	• Number of internal resources or in-house coaching or mentoring roles conducted	Can be accomplished by permanent staff who underwent training		■			DENR-BMB	DENR, DA, LGUs, NGOs, POs, other national government organizations
	• External resources or formal seminars, conferences conducted							
Securing management and staff commitment • Implementation of a Training Working Group within the NISSAP steering Group	• Support to milestones, costs, dates, deliverables			■			DENR-BMB	DENR, DA, LGUs, NGOs, POs, IPs
	• Employee commitment secured	Permanent DENR and DA staff to be assigned and trained on IAS concerns						
	• Training implemented	Staff trainings: Php500,000/staff for 20 staff (10 staff each for DA & DENR; 2 trainings per staff)	10,000,000					
Appropriate training of involved sectors	• Number of involved sectors trained	Php500,000/sector x 5 sectors	2,500,000	■	■		DENR-BMB	DENR, DA, LGUs, NGOs, POs, IPs
TOTAL			**32,000,000**					
GRAND TOTAL			**1,313,764,000**					

Glossary

A

Alien species (non-native, nonindigenous, foreign, exotic)
A species, subspecies, or lower taxon occurring outside of its natural range (past or present) and dispersal potential (i.e., outside the range it occupies naturally or could not occupy without direct or indirect introduction or care by humans) and includes any part, gametes or propagule of such species that might survive and subsequently reproduce.

B

Biocontrol
A pest control strategy making use of living natural enemies, antagonists, or competitors and other self-replicating biotic entities.

Biological Diversity (biodiversity)
The variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part; this includes diversity within species, between species and ecosystems.

E

Exotic species
An organism that exists in the free-state in an area but is not native to that area. It also refers to animals from outside the country in which they are held in captive or free-ranging populations.

I

Invasive Alien Species (IAS) threats (impacts)
Matters or activities which, individually or collectively, may constitute a biological risk to the ecological welfare or to the well-being of humans, animals or plants of a country.

Intentional introduction
An introduction made deliberately by humans involving the purposeful movement of a species outside of its natural range and dispersal potential. Such introductions may be authorized.

Introduced species
Any species transported intentionally or accidentally by a human-mediated vector into habitats outside its native range. Introduced species equate to nonindigenous species and/or exotic species.

Introduction
The movement, by human agency, of a species, subspecies, or lower taxon (including any part, gametes or propagule that might survive and subsequently reproduce) outside its natural range (past or present). This movement can be either within a country or between countries.

Invasive species
An alien species which becomes established in natural or semi-natural ecosystems or habitats, is an agent of change, and threatens native biological diversity.

Invasive Alien Species (IAS)
Species introduced deliberately or unintentionally outside their natural habitats where they have the ability to establish themselves, invade, out-compete natives and take over the new environments.

Invasive Alien Species (IAS) pathway
Any activities or ways that allow the entry or spread of a pest or alien species.

N

Native species (indigenous)
A species, subspecies, or lower taxon, occurring within its natural range (past or present) and dispersal potential (i.e., within

the range it occupies naturally or could occupy without direct or indirect introduction or care by humans.).

Natural ecosystem
An ecosystem not perceptibly altered by humans.

P

Pest
Any species, strain or biotype of plant, animal or pathogenic agent injurious to plants or plant products.

Pest risk analysis
The process of evaluating biological or other scientific and economic evidence to determine whether a pest should be regulated and the strength of any phytosanitary measures to be taken against it

Phytosanitary measure
Any measure applied to protect animal or plant life or health from risks arising from the entry, establishment or spread of pests, diseases, disease-carrying organisms or disease-causing organisms.

R

Re-introduction
An attempt to establish a species in an area which was once part of its historical range, but from which it has been extirpated or become extinct.

S

Sanitary measure
See Phytosanitary measure.

U

Unintentional introduction
An unintended introduction made as a result of a species utilizing humans or human delivery systems as vectors for dispersal outside its natural range.

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Annexes

Annex 1. National Invasive Species Strategy and Action Plan (NISSAP) development consultations and meetings

National Invasive Species Strategy and Action Plan (NISSAP) development was discussed during 6 consultations and meetings held from July 2013 to September 2013. These meetings were attended by various stakeholders and were held in several Philippine cities, see Box A1.1.

Box A1.1: National Invasive Species Strategy and Action Plan (NISSAP) development consultation meetings, 2013

Date	Meeting Title	Venue
15 July 2013	IAS National Steering Committee	The Heritage Hotel Manila, Pasay City
16 July 2013	IAS Experts Meeting and Workshop	View Park Hotel, Tagaytay City
24-26 July 2013	Workshop Session: Goal B of the Aichi Target 9-a component of the Southern Luzon Regional Consultation for Upgrading the Philippine Biodiversity Strategy and Action Plan (PBSAP)	Crowne Plaza Manila Galleria Hotel, Quezon City
27 August 2013	National Consultation	Eurotel, Quezon City
28- 30 August 2013	Workshop Session: Goal B of the Aichi Target 9-a component of the Visayas Regional Consultation for Upgrading the Philippine Biodiversity Strategy and Action Plan (PBSAP)	Harolds Hotel, Cebu City
18-20 September 2013	Workshop Session: Goal B of the Aichi Target 9-a component of the Mindanao Regional Consultation for Upgrading the Philippine Biodiversity Strategy and Action Plan (PBSAP)	The Dynasty Court Hotel, Cagayan de Oro City

Annex 2. Recommended functions of Philippine government institutions

Various stakeholders attended the meetings and consultations during the National Invasive Species Strategy and Action Plan (NISSAP) development. The following are the compiled recommended functions of various Philippine government institutions with active roles and responsibilities in NISSAP.

1. Department of Environment and Natural Resources (DENR)

A. Biodiversity Management Bureau (BMB)

1. Develops cross-sectoral institutional and policy frameworks dealing with IAS management, prevention, control, and eradication;
2. Develops a strong legislation (e.g., Executive Order) on IAS management, prevention, control, and eradication;
3. Develops guidelines on IAS management, field implementation, and monitoring;
4. Develops closer collaboration with neighboring countries to prevent or minimize the threats of IAS at the regional level;
5. Monitors compliance of DENR Field Offices and other government agencies (e.g., BFAR, BPI, BAI) with the rules and regulations on exotic introduction, trade, and captive breeding;
6. Harmonizes policies and regulations, incorporating pragmatic IAS management strategies across sectors and disciplines;
7. Develops a database exchange program, which incorporates IAS biology and ecology, especially with countries involved in the trade of threatened and exotic species.

B. Forest Management Bureau (FMB)

1. Focuses not only on increasing the coverage of reforested areas (i.e., greening) but also on improving the quality of rehabilitated forests for biodiversity conservation.
2. Uses only locally native forest species for the reforestation of denuded areas within NIPAS sites and adjacent agroforestry sites (e.g., in multiple use zones, areas covered by special use agreements/special use agreement in protected areas (SAPA), community-based forestry programs).
3. Incorporates strategies on the control and management of IAS in the Philippine National REDD-plus Strategy (PNRPS). Within the 10-year time period (2010-2020), forest managers should be well-informed of IAS management.
4. Strengthens collaboration with BMB on matters (i.e., policies, programs, projects) pertaining to IAS management and assessment of the potential

impact of IAS on the conservation of threatened native and endemic flora and fauna in protected areas, critical habitats, watershed, and protected forests.

5. Strengthens collaboration with ERDB and other academic and scientific institutions in sustainable forestry practices, including reforestation, ensuring that IAS are not introduced through ecologically unsound rehabilitation practices and reforestation trials.
6. Complies with the EIS system on the introduction of exotic species in protected areas.

C. Environmental Management Bureau (EMB)

1. Strengthens the enforcement of the EIS system at the local level regarding the introduction of exotic and invasive species in protected areas, watershed, and other ecologically critical habitats;
2. Develops a standard monitoring system, in coordination with relevant government agencies, to assess environmental impact of IAS and determine mitigating measures to minimize the impact of IAS pathways coming from industries (e.g., mining, manufacturing, tourism).

D. Ecosystems Research and Development Bureau (ERDB)

1. Strengthens basic and applied research on IAS
2. Develops policy research on setting risk assessment standards on invasive species in collaboration with relevant government agencies, academic institutions, and other research establishments.
3. Develops training programs to enhance capacity to implement policies and programs on IAS
4. Collaborates with other government, non-government organizations and other stakeholders on public education and awareness campaign about the linkage between biodiversity conservation and IAS.

2. Department of Agriculture (DA)

A. Bureau of Fisheries and Aquatic Resources (BFAR)

1. Enhances capacity building of field staff and inspectors on IAS identification and surveillance;
2. Increases budget for IAS monitoring and incentives for field inspectors;
3. Develops a distinct technical unit within BFAR dedicated to IAS matters to plan programs; draft and recommend policies, management measures, and monitoring and evaluation; and to liaise with scientific bodies on IAS biology and ecology;
4. Develops a Task Force that immediately addresses IAS reports from the field;

5. Strengthens collaboration with national agencies and local government units on technical and management issues across sectors.

B. Bureau of Plant Industry (BPI)

1. Strengthens technical and resource capacities in implementing sanitary and phytosanitary standards and protocol;
2. Improves inspection of non-traditional exotic crop materials (e.g., reforestation and ornamental species) that are likely to be invasive.

C. Bureau of Animal Industry (BAI)

1. Strengthens the field implementation of the import/export/transport systems;
2. Improves technical and resource capabilities of field offices and satellite services;
3. Establishes/coordinates activities with DENR and other agencies in the implementation of its regulatory functions with regard tolAS;
4. Adopts the international best practice in the prevention and control of lAS;
5. Strengthens animal quarantine measures on lAS;
6. Develops information System for lAS for information exchange among concerned agencies and partner countries.

Annex 3. Philippine legal instruments prohibiting and/or preventing the introduction of exotic species that may be invasive or potentially invasive.

1. Philippine legal instruments governing wildlife

Box A3.1: Philippine legal instruments governing wildlife species, 2016

Short Title	Long Title	Responsible Lead Government Organization (GO)
Republic Act No. 9147	An Act Providing for the Conservation and Protection of Wildlife Resources and their Habitats, Appropriating Funds therefore and for other Purposes, also known as the "Wildlife Resources Conservation and Protection Act"	DENR-BMB
DENR-DA- Palawan Council for Sustainable Development (PCSD) Administrative Order No. 01	Implementing Rules and Regulations (IRR) of Republic Act 9147 otherwise known as the Wildlife Resources Conservation and Protection Act of 2001,-also known as "Implementing Rules andRegulations (IRR) of Republic Act 9147"	DENR-BMB

The Wildlife Resources Conservation and Protection Act (Republic Act No. 9147) aims primarily to conserve and protect the country's wildlife resources (terrestrial and aquatic) and their habitats for sustainability and to promote ecological balance and enhance critical habitats, which is linked to the loss of biodiversity (Sec 13), and is a proactive measure to prevent their potential impact. Concern for the potential adverse impact of Genetically Modified Organisms (Sec 16), is also raised for the safety of the public, wildlife, and habitats. However, the Act is silent on what to do with IAS that are already present and causing harm to biodiversity.

The Implementing Rules and Regulations (Joint DENR-DA-PCSD Administrative Order No. 01) of RA 9147 underscores that the introduction of exotic species and their progenies in protected areas and critical habitats is prohibited. The IRR also sets the regulations on the transport, importation, exportation, and registration of threatened and non- threatened native and exotic species and their progenies. The importation of exotic species may be allowed by the DENR Secretary or the authorized representative "based on sound ecological, biological and environmental justification resulting from scientific studies, subject to biosafety standards and import risk analysis and/or other sanitary and phytosanitary measures" (Sec 11, Rule 11.3).

2. Philippine legal instruments governing plants

Box A3.2: Philippine legal instruments governing plant species, 2016

Short Title	Long Title	Responsible Lead Government Organization (GO)
Plant Quarantine Decree (PQD) No. 1433	Presidential Decree Promulgating the Plant Quarantine Law of 1978, Thereby Revising and Consolidating Existing Plant Quarantine Laws to Further Improve and Strengthen the Plant Quarantine Service of the Bureau of Plant Industry, also known as the " Plant Quarantine Decree (PQD) of 1978"	DA-BPI
BPI Quarantine Administrative Order No. 1 Series Of 1981.	Promulgating the Plant Quarantine Law of 1978, Thereby Revising and Consolidating Existing Plant Quarantine Laws to Further Improve and Strengthen the Plant Quarantine Service of the Bureau of Plant Industry, also known as the "Rules and Regulations to Implement Presidential Decree No. 1433"	DA-BPI

The Plant Quarantine Decree (PQD) of 1978 and its IRR (BPI Quarantine Administrative Order No. 1 Series of 1981) aims to prevent the entry and spread of plant and animal pests to promote food security. It focuses mainly on avoiding the detrimental impacts of pests and diseases on food productivity and agriculture-based economy rather than on the maintenance of biodiversity. Nonetheless, the required quarantine and the Plant and Phytosanitary measures, which are consistent with the World Trade Organization Sanitary and Phytosanitary Standards (SPS) Agreement, are effective methods to prevent the entry of potentially harmful and most likely invasive species in the Philippines and overseas.

Section 3 of the Plant Quarantine Decree restricts the "importation and/or introduction into the Philippines of plants, plant products, soil, packing materials of plant origin capable of harboring and are a source of medium of infection/infestation of plant pests, subject to quarantine orders, rules and regulations." Likewise, the importation of potential animal pests is prohibited; however, importation in limited quantities for a justifiable purpose and upon a written permit from the Director of Plant Industry may be allowed (Section 4). The criteria to determine a 'justifiable purpose' are neither specified in the Decree nor in the IRR.

3. Philippine legal instruments governing aquatic resources

Box A3.3: Philippine legal instruments governing aquatic resources, 2016

Short Title	Long Title	Responsible Lead Government Organization (GO)
Republic Act No. 8550	An Act Providing for the Development, Management and Conservation of the Fisheries and Aquatic Resources, Integrating all Laws Pertinent Thereto, and for other Purposes, otherwise known as the "Philippine Fisheries Code of 1998"	DA-BFAR
Implementing Rules And Regulations Pursuant To Republic Act No. 8550	An Act Providing for the Development, Management and Conservation of the Fisheries and Aquatic Resources, Integrating all Laws Pertinent Thereto, and for other Purposes", also known as the "Implementing Rules and Regulations (IRR) of the Philippine Fisheries Code of 1998"	DA-BFAR
Fisheries Administrative Order (FAO) No. 214 (2001)	Code of Practice for Aquaculture	DA-BFAR

The Philippine Fisheries Code of 1998 and its Implementing Rules and Regulations require a thorough biosafety assessment to prevent the entry and spread of fish pests and diseases that could lead to low food production and degradation of aquatic habitats. Section 10 states that "no foreign fin fish, mollusks, crustacean or aquatic plants shall be introduced in Philippine waters without a sound ecological, biological and environmental justification based on scientific studies subject to the biosafety standard." The Fisheries Inspection and Quarantine Service is responsible for monitoring and regulating the importation and exportation of fish and fishery/aquatic resources including the implementation of international agreements/commitments on biosafety and biodiversity.

The Code of Practice for Aquaculture (FAO No. 214/2001) requires an Environmental Impact Assessment prior to the approval of proposed projects (e.g., aquaculture) that are likely to cause environmental impact (Sec 3).

Furthermore, the introduction of exotic species -including genetically modified organism (GMOs)-shall be made only after a sound ecological, biological and environmental justification based on scientific studies and subject to the biosafety standards (Sec 8).

4. Philippine legal instruments governing animals

Box A3.4: Philippine legal instruments governing animals, 2016

Short Title	Long Title	Responsible Lead Government Organization (GO)
Act 3639 Dec. 7, 1929	Animal quarantine and inspection to prevent and cure dangerous communicable diseases among the animals	DA-BAI
DA Administrative Order No. 09 Series of 2010	Department of Agriculture Administrative Order NO. 08, series of 2009, as amended	DA-BAI

The Bureau of Animal Industry (BAI) is tasked to investigate, study, and report the causes of communicable diseases in animals (e.g., livestock, pets) and determine measures to prevent the introduction, insurgence, and spread of diseases with an ultimate goal of enhancing the livestock industry in the Philippines. None of the policy and regulatory frameworks of BAI make reference to biodiversity conservation and much less on the impact of invasive animal species on the integrity of the natural ecosystem. However, IAS management can build on BAI's primary role in preventing the entry and spread of animal diseases, affecting not only domestic animals and but also the environment and human health.

The DA-Administrative Order No. 09 Series of 2010 is consistent with the World Trade Organization (WTO) Agreement on the Application of Sanitary and Phytosanitary (SPS) Measures, which recognizes that member-countries have the right to develop SPS measures to protect humans, animals, and plants from communicable diseases. The application of the SPS import clearance procedures, as established in this Order, may apply to animals, plants, fish and their by-products (Sec III). There are also supplementary rules and regulations on the transport (by land, sea, and air), trade, and possession of animals (both livestock and pets), subject to the issuance of appropriate permit, to prevent the introduction and spread of diseases and ensure the welfare of the animals.

5. Philippine legal instruments governing environmental impacts of invasive species

The Environmental Impact Assessment system is an effective measure to prevent the introduction and impact of IAS. Presidential Decree No. 1586 is the fundamental law on the implementation of the Environmental Impact Statement (EIS) system, requiring all agencies and instrumentalities of the national government, government-owned or controlled corporations, private corporations, firms, and entities to undertake EIS for any proposed project that would significantly affect the quality of the environment (Sec 1).

Any proposal involving the introduction of exotic species to protected areas and other declared environmentally critical areas (ECAs) has to undergo the EIS process (Presidential Proclamation 2146). The Proclamation further states that the introduction of exotic species in private/public forests is considered an Environmentally Critical Project (ECP) [Sec an II (3)]. It reiterates that "no person shall undertake or operate any such declared ECP or project within an ECA without first securing an Environmental Compliance Certificate (ECC)."

Annex 4. Activities in the various sectors that are required to conduct environmental impact study/assessment as provided in respective legal instrument

Box A4.1: Philippine legal instruments, sections, and activities regarding wildlife, protected areas, fisheries, and environment, 2016

Legal Instrument	Section/Activity and Quoted Provisions From Legal Instrument
Wildlife Sector	
Republic Act 9147 Wildlife Resources Conservation and Protection Act	**Sec13. Introduction of Exotic Wildlife** *"In cases where introduction is allowed, it shall be subject to environmental impact study which shall focus on the bio-ecology, socioeconomic and related aspects of the area where the species will be introduced."*
	Sec 16. Biosafety *"All activities dealing on genetic engineering and pathogenic organisms in the Philippines, as well as activities requiring the importation, introduction, field release and breeding of organisms that are potentially harmful to man and the environment shall be reviewed in accordance with the biosafety guidelines ensuring public welfare and the protection and conservation of wildlife and their habitats."*
	Sec17. Commercial Breeding or Propagation of Wildlife Resources *"Breeding or propagation of wildlife for commercial purposes shall be allowed …provided that commercial breeding operations for wildlife, whenever appropriate, shall be subject to an environmental impact study"*
Joint DENR-DA PCSD Administrative Order No. 01 Implementing Rules and Regulations (IRR) of Republic Act 9147	**Sec 13. Introduction of Exotic Wildlife Rule 13.2** *"The clearance shall be issued after compliance with the following requirements: a. Environmental impact study focusing on the bioecology, socioeconomic and related aspects of the area where the species will be introduced and status and suitability of the proposed area where the exotic species shall be introduced;"*
	Sec 16. Biosafety Rule 16.2 *"The following activities shall undergo the process of Environmental Impact Assessment (EIA): a. introduction of exotic fauna in private/public forests; b. field release of any pathogenic organism; c. field testing of any genetically-engineered organism: (i) in an Environmentally Critical Area; (ii) the conduct of which has been determined by the DENR-Environmental Management Bureau and the DA-Bureau of Plant Industry, as posting significant risks to the environment."*

Box A4. 1: Philippine legal instruments, sections, and activities regarding wildlife, protected areas, fisheries, and environment, 2016 (continued)

Legal Instrument	Section/Activity and Quoted Provisions From Legal Instrument
Protected Areas Sector	
National Integrated Protected Areas System (NIPAS) Act of 1992.	**Sec 56. Environment Impact Assessment** *"Proposal for activities which are outside the scope of the management plan for protected areas shall be subject to an environmental impact assessment as required by law before they are adopted… No actual implementation of such activities shall be allowed without the required Environment Compliance Certificate (ECC) under the Philippine Environment Impact Assessment (EIA)."*
Revised Implementing Rules and Regulations of the NIPAS Act of 1992.	**Rule 13 Environmental Impact Assessment** *"Considering that protected areas are environmentally Critical Areas (ECA), the proponent of development projects and activities with potential environmental damage as determined by Environmental Management Bureau, whether or not included in the Management Plan, shall secure an environmental Compliance Certificate (ECC) in accordance with the Philippine Environment Impact Statement (EIS) System. Provided, that for development project and activity within the Management Plan, an Initial Environmental Examination (IEE) can be undertaken instead of a full-blown Environmental Impact Assessment (EIA)."*
DAO No. 2007-17. Rules and Regulations Governing Special Uses within Protected Areas	**Sec 5. Kinds of Special Uses** *"The following are the special uses, that may be allowed, but not limited to, within protected areas, subject to the issuance of an environmental Compliance Certificate (ECC) and approval by the Secretary or his duly authorized representative"*
Fisheries Sector	
The Philippine Fisheries Code of 1998	**Rule 12.1 Establishment of Environmental Unit in BFAR** *"The Department shall establish an environmental Unit in BFAR to coordinate with concerned agencies in assisting project proponents in preparing Environmental Impact Statement prior to its submission to DENR"*
Environment Sector	
The National Biosafety Framework (NBF) for the Philippines (2004)	*"The application of the Philippine environmental Impact Assessment System to biosafety decisions shall be determined by concerned departments and agencies subject to the requirements of law and the standards set by the NCBP (p. 18)"*

Annex 5. Examples of quarantine regulations issued to control the spread of crop pests in the Philippines

BPI Quarantine Administrative Order No. 15 S1988, Modifying BPI Administrative Order No. 06, Series of 1949 (Revised) entitled "Declaring the Coconut "Cadang-cadang" a Dangerous Disease: Providing for its Control, and Placing Under Quarantine All the Provinces where the Disease Already Exists, and Issued by the Director of Plant Industry Pursuant to Act 3027

BPI Special Quarantine Administrative Order No. 20 S1987, Declaring Mango Pulp Weevil (*Sternochetus frigidus*) (Fabr.) A Dangerous Pest and Injurious to Mangoes and Placing the Palawan Island Group under Quarantine to Prevent the Spread of Said Pest

BPI Special Quarantine Administrative Order No. D-1 S1985, Declaring *Salvinia molesta*, D.S.5Mitchell as a Noxious Weed and Placing under Quarantine the Provinces of Aklan, Antique, Capiz and Iloilo; in the Island of Panay; the sub-province of Guimaras and Negros island, to Prevent its Spread to Other Areas in the Philippines

BPI Administrative Order No. 18 Series of 1987. Declaring the Mollusk *Ampularia gigas* locally known as the "Golden Kuhol", as a serious plant pest and providing measures to regulate and control its spread.

BPI Special Quarantine Order No. 01 S2005, Declaring American Foul Brood (AFB), a Serious Disease of European Honey Bee, *Apis mellifera*, and Providing Measures to Regulate and Prevent its Spread

BPI Special Quarantine Order No. 01 S2007, Amendment to BPI Special Quarantine Order No. 03, Series of 2005, Declaring Coconut Leaf Beetle, *Brontispa longissima* (Gestro) an Invasive Quarantine Pest of Coconut, *Cocos nucifera*, and Providing Measures to Regulate and Prevent its Spread

BPI Special Quarantine Order No. 02 S2005, Quarantine Measures to Prevent the Introduction and Spread of Chlorotic Ringspot Virus of Oil Palm

BPI Special Quarantine Order No. 03 S2005, Declaring Coconut Leaf Beetle, *Brontispa longissimi* (Gestro) an Invasive Quarantine Pest of Coconut, *Cocos nucifera*, and Providing Measures to Regulate and Prevent its Spread

BPI Special Quarantine Order No. D-1 S1982, Declaring Socorro Wilt of Coconut as Dangerous and Injurious Coconut Disease and Likewise Declaring the Island of Mindoro and Other Places Where the same may be found to Exist, Under Quarantine to prevent its spread from Infested Areas to Non-infested Areas

BPI Special Quarantine Order No. D-2 S1982, Declaring Rice Black Bug (*Scotinophora* spp. Burm), a Dangerous Pest of Rice and Declaring the Palawan Group of Islands under Quarantine to Prevent the Spread thereof to Other Parts of the Philippines

BPI Special Quarantine Order No. I-1 S1982, Regulating the Importation of Mango Plants (*Mangifera* spp.) and Parts thereof from Places, Areas and Countries Infested with Mango Malformation or Bunchy-Top, Woody-Gall and Scaly Bark (*Cuarteado*), Diseases of Mango in Order to Prevent their Introduction into the Philippines

BPI Quarantine Administrative Order No. 15 S1988, Modifying BPI Administrative Order No. 06, Series of 1949 (Revised) entitled "Declaring the Coconut "Cadang-cadang" a Dangerous Disease: Providing for its Control, and Placing Under Quarantine All the Provinces where the Disease Already Exists, and Issued by the Director of Plant Industry Pursuant to Act 3027

BPI Special Quarantine Administrative Order No. 20 S1987, Declaring Mango Pulp Weevil (*Sternochetus frigidus*) (Fabr.) A Dangerous Pest and Injurious to Mangoes and Placing the Palawan Island Group under Quarantine to Prevent the Spread of Said Pest

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Annex 6. Invasive Alien Species (IAS)-relevant international treaties and agreements signed/ratified by the Philippines

Box A6.1: Invasive Alien Species (IAS)-relevant treaties and agreements signed/ratified by the Philippines, 2016

Convention	Date	IAS engagement	IAS Focus		
			Species	Pathway	Ecosystem
Convention on Biological Diversity (CBD)	Ratified October 10, 1993	Very active	■	■	■
International Plant Protection Convention (IPPC)	Ratified December 3, 1953	Very active	■	■	■
World Trade Organization (WTO) Agreement on the application of sanitary and phytosanitary measure	Signed January 1, 1995	Very active		■	
International Maritime Organization: Ballast Water Convention (BWC)	Member 1964	Very active		■	
Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)	Ratified August 18, 1981	Active	■	■	
Ramsar Convention on Wetlands (Ramsar)	Ratified November 8,1994	Active			■
The World Organization for Animal Health (OIE)	Entry to force January 25, 1924	Active	■		
Convention on the Conservation of Migratory Species of Wild Animals	Entry to force January 2, 1994	Potential	■		
United Nations Framework Convention and Climate Change (UNFCCC)	Ratified August 2, 1994	Potential			■
Cartagena Protocol on Biosafety to the Convention on Biological Diversity (Cartagena Protocol on Biosafety)	Ratified October 5, 2006	Potential		■	
United Nations Convention to Combat Desertification (UNCCD)	Ratified February 10,2000	Potential			■
United Nations Convention on the Law of the Sea (UNCLOS)	Ratified May 8, 1984	Potential			■

Reference: CBD, 2011

Annex 7. Summary of the enabling polices, regulations and institutional frameworks, United National Environment Program (UNEP). 2013. The enabling policy and institutional environment for Invasive Alien Species management in the Philippines.

Final Report submitted to CABI under the UNEP- Global Environment Facility (GEF) Project: Removing Barriers to Invasive Species Management in Production and Protection Forests in Southeast Asia (UNEP/GEF 0515 Project)

SUMMARY

1. The major government organizations that are most relevant to the implementation of IAS in the Philippines are the Department of Environment and Natural Resources (DENR) and the Department of Agriculture (DA). The Bureaus under DENR that are most relevant to the issues and management of IAS are the Biodiversity Management Bureau (BMB), Forest Management Bureau (FMB), Environmental Management Bureau (EMB), and Ecosystem Research and Development Bureau (ERDB), while those under DA are the Bureau of Plant Industry (BPI), Bureau of Animal Industry (BAI), and Bureau of Fisheries and Aquatic Resources (BFAR).
2. The enabling legislation for the establishment of these institutions, dates of establishment, overall institutional responsibilities, and actions (including those that produce problems), and recommendations relevant to IAS management were presented.
3. The results of the content analysis of the enabling policy and regulatory frameworks were grouped into sectors: wildlife, forestry, agricultural plants, fisheries, protected areas, tourism, and environment. Gaps, inconsistencies, and recommendations are presented.

a. Wildlife

The most IAS-relevant legal instruments on wildlife management initiated by DENR-BMB are the Wildlife Resources Conservation and Protection Act and the conserve and manage wildlife (i.e., plants and animals, threatened and non-threatened, native and exotic). However, they are mostly focused on exotic species in trade (in accordance with CITES provisions) and other commercial and personal purposes. The legal treatment of IAS management as a holistic approach to halting biodiversity conservation is limited. RA 9147 provides only a broad definition of 'exotic species' without linking them to their potential invasiveness. The term 'Invasive Alien Species (IAS)' is neither defined nor mentioned in the text. The term 'invasive' is not mentioned in the text of the IRR either.

The prohibition of introducing exotic species (Sec 13) and GMOs (Sec 16) is an effective preventive measure against the potential damage of IAS in protected areas and critical habitats. The review of subsidiary legal instruments – Department Administrative Order (DAO) and Department Memorandum Circular (DMC)- in support of the implementation of the Wildlife Resources Conservation and Protection Act and its Implementing Rules and Regulations showed that they too can offer some basic preventive measures in case there would be intentional or unintentional introduction of exotic species into the environment.

Even though the legislative measures addressing IAS are still at a rudimentary stage, the current initiatives in wildlife conservation and management can inform the development of an IAS-focused policy framework and management strategies in the context of biodiversity conservation in the Philippines.

b. Forestry

The Revised Forestry Code of the Philippines Presidential Decree (PD) 705 does not make any reference to exotic species or their potentially invasive nature even though Section 37 states that "measures shall be taken to protect the forest resources from destruction, impairment and depletion." Some forest policy development initiatives (e.g., EO 318) have been leaning towards forest sustainability and maintenance of ecosystem integrity. This may be interpreted to mean that concerns regarding the adverse consequences of human pressure on forest may as well include IAS management. The agroforestry (DAO 25-2005) and 'rainforestation' (DMC 2004-06) policies and regulations prescribe the use of native species. Given that the desired outcome of agroforestry is meant to be beneficial and positive, it is important to clarify within the policy that crops and livestock that will be propagated/cultivated in agroforestry farms have to be adequately screened for invasiveness as well as for biosafety as they can also become vectors of pests and diseases. Agroforestry farms, especially those located close to the forest interior, can be pathways to species invasion. The use of fast-growing exotic species in reforestation species is a common and embedded practice in the Philippines. Knowing now that many of them are invasive and to reinforce biodiversity in forest ecosystem, the use of native species, preferably those that are locally adapted, should be promoted. The implementation of the National Greening Program (DMC 2011) is an opportunity to encourage the planting of different mix of native species for the rehabilitation of protected areas in order to simulate the heterogeneous characteristics of natural tropical forests. Enabling forestry policy to support the development of IAS management program should integrate preventive and control measures against the introduction and spread of invasive alien reforestation species in protected forests.

Enabling forestry policy to support the development of IAS management program should integrate preventive and control measures against the introduction and spread of invasive alien reforestation species in protected areas.

c. Agricultural plants

The relevant basic policy in national crop protection and production in the Philippines is embodied in the Plant Quarantine Decree of 1978, requiring quarantine check on all imported plants and plant materials. The Decree, however, focuses mainly on the detrimental impact of pest and diseases on food productivity and agriculture-based economy rather than on the maintenance of biodiversity.

The IRR pursuant to the "Plant Quarantine Decree of 1978" outlines the methods to improve the plant quarantine services being offered by the Bureau of Plant Industry (BPI) with respect to the importation/exportation of agricultural crops and other plant materials. Furthermore, BPI Administrative Order No. 8 Series of 2002 sets regulations on the importation and release of GMOs into the environment. It is implied that GMOs can be potentially harmful and invasive. A biosafety safeguard for imported plant materials is implemented in accordance with the national protocol and consistent with the Sanitary and Phytosanitary Standards (SPS) set by the International Plant Protection Convention.

More in-depth training for field inspectors on the use of the SPS measures is needed. Furthermore, the pest risk analysis protocol for imported/exported products should also include measures for the early detection and control of IAS pathways in agroforestry and reforestation.

d. Domestic animals

The Bureau of Animal Industry (BAI) is tasked to investigate, study, and report the causes of communicable diseases in animals (e.g., livestock, pets) and determine measures to prevent the introduction, insurgence, and spread of diseases with an ultimate goal of enhancing the livestock industry in the Philippines. None of the policy and regulatory frameworks of BAI make reference to biodiversity conservation and much less on the impact of invasive species on the integrity of the natural ecosystem. However, IAS management can build on BAI's primary role relating to the prevention, control, and eradication of animal diseases, which can also be harmful invasive species affecting not only the domestic animals but also the environment. An understanding of the IAS pathways, such as the methods of domestic and international transport of domesticated animals, is useful in developing an environmentally-sound IAS management plan.

e. Fisheries

The Philippine Fisheries Code of 1998 requires a thorough biosafety assessment to prevent the spread of fish pests and diseases that could lead to low food production and degradation of aquatic habitats. It also requires an Environmental Impact Assessment prior to the approval of proposed projects (e.g., aquaculture) that are likely to cause environmental impact.

The Bureau of Fisheries and Aquatic Resources (BFAR) ensures that aquatic species introduced to the Philippines are assessed for the presence of pests and diseases through a systematic biosafety check. The current implementation of the biosafety measures, however, is not adequate to predict the potential invasiveness of any exotic species if in case they were accidentally or purposely released into the environment. IAS management (i.e., exotic species and GMO introduction) is implied in the text of Fisheries Administrative Order (FAO) 233 (Aquatic Wildlife Conservation). The export/import of native species is generally regulated in compliance with CITES and the Philippine Wildlife Conservation and Protection Act. There is a need to develop a collaborative program to address invasive alien species in natural inland waters especially those that are located in protected areas. Preventing the intentional and unintentional introduction of IAS should be given high priority over the more expensive and difficult management strategies in controlling and eradicating IAS.

f. Protected Areas

The NIPAS Act (RA 7546) is the fundamental national policy on *in-situ* conservation of biodiversity through the establishment and management of protected areas. The list of terms (Sec 4) does not include the definition of IAS-associated terms such as 'exotic,' 'invasive species' or 'pest.' 'Pest management' is mentioned only once in the text of the Act and only as a management strategy in protected area planning (Sec 9).

In the Revised IRR (DAO 2008-26), the term 'invasive species' is not defined but mentioned as one of the threatening factors that justifies that need to establish a buffer zone.

(Rule 9.1). 'Pest management' is implicitly mentioned as a planning strategy for protected area management (Rule 10). Although not defined, 'pest management' may be interpreted to include both plant and animal pests and pathogens.

Because special uses within the multiple use zone of protected areas (DAO 2007-17) can be pathways of IAS into the cores zone, risk assessment should be incorporated in the implementation of the EIS and the issuance of the Special Uses within Protected Areas (SAPA) agreement. The negative impact of IAS on protected areas would be magnified if the delineation and management of the multiple use zone and the strict protection zone (DAO 2008-17) is not carefully assessed and implemented. The juxtaposition of the multiple use zone to the strict protection zone is an important consideration in the management of NIPAS sites when taking into account IAS introduction and dispersal. The implementation of the Order should consider planting strips of mixed species of indigenous trees between the two zones to serve as a 'natural buffer' so as to retard the dispersal of IAS propagules from the multiple use zone to the strict protection zone. Its

success, however, will depend not only on the type of native species planted and the method of planting used but also on the width or extent of such strips.

Conflicting orders, such as the re-classification of small islands (<500 ha) as alienable and disposable land, can trigger massive extinction of island endemics not only because of increasing human pressure but also because of the inherent vulnerability of island ecosystem to IAS.

g. Legislated NIPAS sites

A content analysis of Republic Acts and IRRs of some legislated NIPAS sites was also conducted to determine if IAS management has been considered in the formulation of the legislative instruments. The study found that there is no consistency in the treatment of "exotic' species and IAS management. While some policies and IRRs (e.g., Tubbataha Reefs Natural Park, Mt. Kanla-on Natural Park) have provided a relatively better treatment (albeit rudimentary) of IAS management, others (e.g., Mt. Apo Natural Park, Sagay Marine Reserve) have only inferred or vaguely implied the issue of alien invasion. It is crucial that PAMBs take into account the threat of IAS on protected areas and ensure that IAS management efforts are incorporated in the respective NIPAS management plans.

h. Ecotourism

A big gap in the context of IAS management exists in the policy and regulatory frameworks of ecotourism in protected areas. The national ecotourism policy and program of the Philippines have neither implied nor inferred IAS management, even though ecotourism fundamentally aims to promote biodiversity conservation in nature-based destinations.

The notion of IAS or the ecological implication of accidental/intentional introduction of exotic species by tourists is not mentioned in any part of the Philippine National Ecosystem Strategy (PNES). The National Ecotourism Program (NEP) does not also make any inference to tourism as a major IAS pathway. Of the 32 banner ecotourism sites identified in NEP, more than 50% are within protected areas. Visitor impact management strategy to address, among others, the impact of tourism as an IAS pathway in protected area is not also mentioned in RA 9593 (Tourism Act of 2009). Protected areas that are open to wilderness and trekking adventure are vulnerable to the introduction and spread of IAS.

The tourism industry and tourists should be made aware of the potential harm of IAS that are 'hitchhiking' to nature-based destinations. The Department of Tourism (DoT) and DENR should collaborate in policy development and promotion of good practice in ecotourism in the Philippines.

i. Environment

PD 1586 is the fundamental law on implementation of the Environmental Impact Statement (EIS) system, requiring proponents to undertake an environmental impact assessment of proposed projects that are likely to cause environmental harm (Sec 1). Presidential Proclamation 2146 gives implicit reference to IAS, stating that any proposal involving the introduction of exotic species to protected areas and other declared environmentally critical areas has to undergo the EIS process.

The Proclamation further states that the introduction of exotic species in private/public forests is considered as an Environmentally Critical Project (ECP) [Sec an II (3)]. The EIS requirement for certain proposed projects/activities is explicitly mentioned in the following IAS-relevant policies: RA 9147 Wildlife Resources Conservation and Protection Act (Sections 13, 16, and 17); National Integrated Protected Areas System Act of 1992 (Sec 56); the Philippine Fisheries Code of 1998 (Rule 12.1); and programs, such as the National Biosafety Framework for the Philippines (p.18). The EIS requirement is reinforced in the respective IRRs.

j. International Commitments and Agreements

The relevant international conventions, treaties, and agreements are briefly discussed. The Philippine compliance with these commitments will enable the country to contribute to the global effort to halt biodiversity resulting from the invasion of alien species.

- Convention on Biological Diversity (CBD)
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)
- Convention on Wetlands (Ramsar Convention)
- Convention on the Conservation of Migratory Species of Wild Animals (CMS or the Bonn Convention)
- International Plant Protection Convention (IPPC)
- Sanitary and Phytosanitary Agreement (SPS Agreement)
- International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM Convention)
- United Nations Framework Convention on Climate Change (UNFCCC)
- Cartagena Protocol on Biosafety
- United Nations Convention on the Law of the Sea (UNCLOS/Law of the Sea)
- United Nations Convention to Combat Desertification (UNCCD)
- ASEAN Agreement on the Conservation of Nature and Natural Resources

k. Research

There is limited in-depth and science-based information about the biology and ecology of invasive alien species in the Philippines. Given that the impacts of IAS are not usually manifested until after several years, even decades, from initial introduction and to be consistent with the Precautionary Principle, it is prudent to be cautious even in the absence of such data.

In the absence of complete research data, the danger of IAS in protected areas and forests can be deduced from preliminary field observation/studies. For example, an initial qualitative study demonstrating a correlation between the extent of colonization of an exotic species and the decline of native species will provide an early warning to signal for an immediate and pragmatic management decision. Research on different control measures (e.g., biological, mechanical, chemical) is urgent and necessary. A landscape approach to IAS management has to be explored as well.

Research data provide support to policy-makers and managers in determining gaps and management options to improve the effectiveness of any IAS management effort. Basic data on the characteristics and trends of various IAS pathways will provide a better understanding on how to address the intentional and unintentional introductions of IAS, each presenting different policy and management challenges. Access to information about IAS through a database management system is an effective tool in IAS prevention and management.

The relevant research undertaken by ERDB and other academic institutions, which have positive and negative implications to IAS management, are presented.

Annex 8. Policy and regulatory recommendations by sector

1. Wildlife

1. Strengthen field implementation and enforcement of the policy and implementing rules and regulations on the introduction, transport, and possession of and trade in exotic species;
2. Closely collaborate with other government agencies and other relevant stakeholders by providing technical and policy guidance on Invasive Alien Species (IAS) management, particularly on the aspects of prevention and early detection;
3. Develop species-specific guidance on the control and management of high priority IAS in consultation with scientific bodies/institutions;
4. Provide, in consultation with relevant experts, a national lists of exotic species, both in trade and other purposes, that are likely to be invasive based on certain criteria, such as history of invasion in other countries; biology (e.g.., fecundity, fertility and dispersal ability); and characteristics of the IAS pathway.

2. Forestry

1. Specific regulatory measures on IAS have to be formulated in close collaboration with BMB and relevant agencies and organizations in accordance with Wildlife Conservation and Protection Act and the National Integrated Protected Areas System (NIPAS) Act;
2. Department of Environment and Natural Resources-Forest Management Bureau (DENR-FMB) should coordinate with the Protected Area Management Board (PAMB) in formulating and implementing resolutions relevant to IAS management within protected forests;
3. Only a mix of native forest trees should be used in the rehabilitation/reforestation of protected areas, critical habitats, watersheds and protected forest in response to the National Greening Program. These trees have to be locally suitable and biologically compatible with native plants.
4. Genetically modified trees in reforestation trials should not be used without thorough biosafety check and compliance with the Environmental Impact System (EIS) regulations;
5. The method of planting as well as the proper selection of native forest trees for delineation marking should be incorporated in the management plan of all appropriate NIPAS sites;
6. The use of mixed species of native species as delineation markers between the multiple use zone and the strict protection zone in protected areas should be promoted to prevent the introduction or dispersal of IAS propagules into the forest interior;

7. The use of agroforestry crops that have high risk of being invasive should be prohibited;
8. Forest Management Bureau (FMB) should coordinate with Department of Agriculture-Bureau of Plant Industry (DA-BPI) to ensure that biosafety measures are applied to all new and exotic planting materials for reforestation and agroforestry purposes;
9. FMB can incorporate IAS-control and eradication requirements for all upland and community-based forest agreements.

3. Agricultural Plants

1. Integrate IAS management in the pest risk analysis of all plant materials (commercial and non-commercial) and provide measures for early detection and control;
2. Coordinate with DENR-FMB on the biosafety check of reforestation plants and byproducts including GMOs;
3. Conduct regular and more intensive staff training on the use of the International Plant Phytosanitary (IPP) Portal;
4. Share information on sanitary and phytosanitary issues through the International Phytosanitary Portal;
5. Coordinate with DENR on the proper treatment of native wildlife (e.g., monkey, bats, and birds) that are considered 'pests' by DA.

4. Domestic Animals

1. Strengthen field efforts in the implementation of the policy and rules and regulations;
2. Enhance public awareness and responsibility towards animals and pets;
3. Coordinate with other agencies, in particular DENR, on the prevention, control, and management of diseases in wild animals, both in captivity and in the wild, including those in domestic and international trade.

5. Fisheries

1. Strengthen collaborative efforts to address invasive aquatic alien species in natural inland waters especially those that are located in protected areas;
2. Conduct a systematic survey of the impact of IAS on native endemic fish where aquaculture has been established, legally or illegally;
3. Monitor closely the IAS pathway in aquaculture;
4. Involve Fisheries and Aquatic Resources Management Councils (FARMCs) in monitoring the introduction and release of exotic species and provide assistance in early detection, control, and containment of IAS;

5. Incorporate IAS management as one of the major responsibilities of existing institutional units within Protected Areas
6. Re-assess the impact of policies and rules, such as the Administrative Orders on zoning, management planning, restoration, etc., that can magnify the negative consequences of IAS in protected areas;
7. Ensure that only a mix of indigenous species are used in the rehabilitation/reforestation of degraded portions of protected areas and critical habitats as well as areas that are in juxtaposition to ecologically sensitive communities;
8. Preferential use of wild, native fruit-bearing plants in forest restoration or reforestation to simulate the forest successional stages and to attract native fauna;
9. Harmonize the Republic Acts and the corresponding IRRs of all NIPAS sites in accordance with the fundamental principles of the NIPAS Act of 1992.

6. Ecotourism

1. Formulate specific tourism policies incorporating IAS concerns in NIPAS sites;
2. Formulate codes of conduct for tourists and tour operators focusing on visitor impact management, underscoring the potential harm of IAS on destination sites with high biodiversity value;
3. Develop ecologically sustainable tourism practices built on the core principles of biodiversity conservation through the prevention and control of IAS in protected areas and critical habitats;
4. Encourage ecotourists to get involved in the early detection, control, and eradication of IAS at recreational zones within NIPAS sites;
5. Implement the EIS system for all proposed tourism projects/activities in protected areas and other Environmentally Critical Areas (ECAs).

7. Environment

1. Strengthen the implementation of the EIS system for projects involving the introduction of exotic species in protected areas and critical habitats, especially in areas where native species have similar ecological requirements as the exotic species;
2. Implement EIS for projects involving the introduction of species in areas where native species do not have natural predators (e.g., island endemics);
3. Implement the provision stating that the introduction of exotic species in private/public forests is considered an Environmentally Critical Project (ECP) (Sec AII, 3), and all proposed projects have to submit a full-blown EIS instead of a mere IEE checklist;
4. Require an Environmental Guarantee Fund as an insurance payment for any damage, including the impact from IAS introduction, release, and dispersal, and to cover the restoration cost and compensation damage.

8. Research

Basic Research

1. Research data are needed to determine the characteristics of potentially invasive species. The data can inform the ranking of exotic species according to IAS risks and setting conservation priorities.
2. Basic research in taxonomy and ecology of IAS (species distribution, competition, landscape/ecosystem management) is essential in IAS management. The basic parameters to be assessed may include:

    - Taxonomic and/or common/local name;
    - Biology and ecology of both exotic species and native species that are likely to be affected-for example, determine if both have the same food and space requirements;
    - Presence/absence of natural predators;
    - Characteristics of the area where the introduction of exotic species will occur-for example, clearings, proximity to the forest, roadsides, near water courses

3. The ecological information needed to determine the threats of IAS at the landscape level are as follows:

    - Land use types- forest fragments, urban, grassland/pasture, wetlands;
    - Distribution and abundance of IAS;
    - Changes in the structure of the vegetation or habitat;
    - Changes in the distribution and abundance of the native species; types of interaction between IAS and native species (e.g., predation, parasitism, competition);
    - Other decimating factors within the study area. Applied (Management) Research

Applied/Management Research

1. Formulate and implement research and development (R &D) projects/programs on IAS impacts on biodiversity;
2. Provide science-based advice on policy development and decision-making process regarding IAS control and management;
3. Develop management strategies to halt pests and diseases of native and exotic plants;
4. Develop a comprehensive and accessible national database system on IAS.
5. Prevent or minimize the occurrence of IAS dispersal from reforestation demo-farms and nurseries to nearby forest reserves (e.g., Mt. Makiling Forest Reserve).

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